THE CANARD PUSHER

NO. 10 **OCT '76**

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RAF ACTIVITY Since the last newsletter has included a wide range of projects. The VariEze plans (Section I) were put on the market in early July. Demand for the plans far exceeded our expectations and at times our ability to keep up with orders. Apologies to those who had to wait several weeks for plans. Both the VariViggen and VariEze homebuilt prototypes flew to Oshkosh this year for the EAA convention. Both the VariEze and VariViggen performed in many of the evening airshows during the convention. Oshkosh was a busy nine day event for us. Each day we had a 'builders only' discussion session at both the VariViggen and the VariEze. In addition we conducted a daily two-hour construction seminar in the work shop and three forums. We are hoping to have home-built VariViggens and EZE'S at Oshkosh '77 to take a little of the heat off of the prototypes!

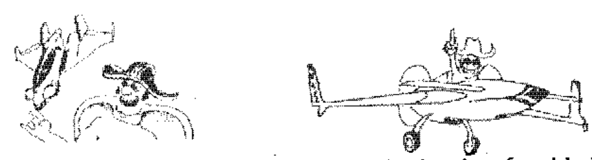
Our summer has been a fast one. The Section I orders, builder support trips, etc. has really kept us at a gallop. Those of you who have ordered Sections IIA, III, and V know that they are not available yet, partly due to the summer's hectic pace and partly due to distractions. We had to do some additional flight test work on the fuel system in preparation for Section IIA. We also completed the detail design of a research airplane for N.A.S.A. utilizing VariEze technology. The N.A.S.A. airplane is a small, one-pilot test vehicle that is intended to test the handling characteristics of a future (1990's) yawed-wing airliner. We are currently proof reading Section IIA and it will go to press shortly. With allowance for printing holdups Section IIA should be available by the first of November; Sections III and V should follow in mid-November.

The VariEze distributors appear to be gaining on their back-log of orders now that the materials pipeline is filling. Aircraft Spruce and Wicks have indicated that the basic materials are now being shipped with-in four to eight weeks of order. Check with them directly for a current lead time. Ken Brock advises us that he is shipping wing fittings and has most of the nose gear parts available now. Those items which Ken doesn't have available yet are not shown on his brochures; he will notify you when they are ready.

We have firmed up our construction seminar schedule for the fall. These seminars are really just for builders and those who have at least studied the education chapter. Don't encourage a group that is just idly curious to attend this just crowds the seminars and makes it hard for active builders to get thei questions answered. If you plan to attend a seminar and have questionable or defective parts, be sure to bring them along. Swallow your pride and let other builders profit from your mistakes.

October 9 and 10 Contact:	Highland, Illinois Wicks Organ Company 1100 - 5th Street Highland, Illinois 62249
October 23	Mojave California at RAF
October 30 and 31 Contact:	Boston, Massachusetts Dale Findlay Aero Sport Inc. Minuteman Fi.. Box Borough Road Stow, Massachusetts 01775 (617) 897-6021
November 6 - 14 Contact:	England and France Harold Best - Devereux. 13 Stonehills House Welwyn Garden City Herts, England
November 21 Contact:	Austin, Texas Bob Wahrmund EAA Chapter 187 Route 1 Box 119B Round Rock, Texas 78664
November 28	Mojave, California at RAF noon - 6:00
December 5 Contact:	Sacramento, California Ed Hamlin 8377 Seeno Avenue Roseville, California 95678
December 18 Contact:	Atlanta, Georgia John Griffin, Sr. 420 Northland Road Mableton, Georgia 30059
December 19 Contact:	Daytona Beach, Florida William Cook 130 North Highland Avenue Daytona Beach, Florida 32014

If you want to attend any of these seminars send the contact a postcard and tell him how many in your party. If you want a reply, send a S.A.S.E.



We have heard from a couple of clubs that have been formed by VariEze builders for mutual support. One group in Minnesota is so big that they have become a special interest EAA chapter! The club idea is a good one, in that builders can better aid each other in construction problems.

We have received N.A.S.A.D. approval, class one (average amateur), for the VariEze plans.

If you want to stop by RAF and visit, give us a call first and make sure we are home. We are not able to show the prototypes on an individual basis yet. If you want to see the airplane please plan to attend one of the seminars in Mojave or hold off until after January. We will be in a different building after January and will have a showroom/hangar where you can see the airplanes. We are a mile from our aircraft now which makes showing them individually an awkward thing to do.

MATERIALS DISTRIBUTION

In the initial rush for materials that followed our release of Section I last June, the distributors were completely swamped. Frankly there were a whole bunch more ready-to-start builders than we ever dreamed of and the result was almost immediate exhaustion of available materials. In the wake of the delays which followed we have received a few complaints from builders who have had to wait six to ten weeks for materials from our distributors and we feel that we owe everybody a brief explanation of how the present distribution system came to be.

RAF is a very small company with no desire to expand into distribution or manufacture of materials or components. When we originally started planning to market plans for the VariEze we were not going to be referring customers to any specific source for materials, since all materials were to be available in just about any reasonable-size city. We were going to build the airplane with a common industrial weave of glass cloth, with a popular Shell laminating epoxy system and with any type urethane foams, available at any well stocked building-supply outlet. We would thus be able to give the specifications in the plans and let the homebuilder find his own source of materials. When we started building N7EZ (then called the mini-Viggen) we ran into some problems. The glass layups were quite difficult in many areas and looked beyond the capability of many all-thumbs builders who would want to build one, and there was a large weight variance due to workmanship. Thanks to Fred Jiran, the glass sailplane wizzard, we found a solution: specially designed weaves of glass cloth that took most of the work out of the layups, resulted in far less weight variation, and fewer man-hours than the materials we had been using. We then realized that not only would the materials be easy to work with, but also construction would be much quicker than working with conventional wood or metal. It was then that the name 'VariEze' was adopted. This, of course, threw a wrench into our plans to not market materials, since the cloth was available only in Europe and required a large special order to get it made here. We then decided to invest in a special order, sell the cloth to the homebuilder, and let him scrounge the remaining material wherever he could.

Next, we ran into several problems with the epoxy. Its toxicity was uite high (SPI-4), mix ratio at 12 percent was very critical and we were ertain we would need two pot lives due to the exotherm damage we found on ur high temperature insulated tests. Thus, due to the high ventilation nd skin protection requirements and uncertainty of local availability of the equired hardener systems, the viability of the project was in doubt. About that ime we met with several composite engineers working in the advanced omposite development department of a large aerospace corporation. We had a eeting at their facility and described the entire VariEze structure to them nd discussed with them the epoxy problems we were experiencing. They were nxious to not only solve our problems but also to suggest that recent deelopments of elastomeric - modified epoxy systems would greatly add to the atigue life and peel strengths in our structure. We initially tried a ommercially available system but found the work-ability poor due to higher iscosity and the pot life still not optimum. What followed was a long series f testing numerous variations, attempting to optimize the formulation of the poxy system. Building components for N4EZ (the homebuilt prototype), samples or strength, environmental and exotherm tests, gave us a good basis to valuate the system for not only physical properties but also for work-ability. he result was a system that was not only less toxic (SPI - 2) but also had onsiderably better fatigue and peel strengths (data are shown in an article n the July issue of "Sport Aviation").

Since marketing glass and epoxy was beyond the scope of materials istribution we were interested in, we decided to have a couple of established istributors stock the epoxy. Then came the bad news. Yes, formulators would e happy to formulate the epoxy system but the retail price would be almost 35.00-per-gallon kit, almost twice the retail price of the original Shell ystem and adding $200.00 to the price of the airplane. We then decided to ave the distributors stock both the Shell and the new system (now designated AE) and give the homebuilder his choice, noting that certain aspects of the onstruction methods and the physical properties would suffer with the lower ost material. One of the composite design engineers who had helped develop he formulation, offered to do the production formulation himself, to reduce osts over the large packaging companies and to protect his proprietary rights n the formula. We were then able to get the retail distributors to lower he normal markup for the epoxy and get the retail price down to $24.75 per-gallon it, which would add only $85.00 over the price of the low-cost system per irplane. Thus, rather than go thru the expensive process of determining nd qualifying the required hardeners for the low cost resin to obtain the orrect pot life times, we decided to not delay the program and to have the istributors supply only RAE.

At that time there were other individuals offering to supply builders ith various materials and were sending samples for our "approval". We learned wo things from this experience: (1) It is very time consuming and expensive o do all tests required to gain confidence in a given structural material and 2) there is a very wide range of quality and acceptability in many of the materials, particularly the foams. Now that we had just solved the glass and epoxy problem we had a foam problem. We were concerned that the homebuilder would be sold inadequate foams, totally in good faith, by outlets who did not understand the importance of the proper physical characteristics and of quality control. The only way we could assure the homebuilder of getti the right materials was to specify it to the distributors and follow-up to assure quality control. The foams also presented an availability problem, since only one plant in the United States manufactures the blue foam in the correct cell size and in large enough blocks. The PVC foam must be imported from Europe and is quite expensive (typical retail price for the blue and green is 50 - 60¢/bd foot; PVC is generally much higher).

With our mind at ease that the homebuilder would be able to get satisfactory structural materials, the distributors wanted to also make up a hardware and metals kit, to allow builders to avoid the hassle of rounding up the numerous other items. We felt this was a good idea but insisted that they retail any item individually.

Prices - as you may know, we had estimated that raw materials cost for a VariEze (less engine) would be about $1,400.00 and about $2,700.00 if you elected to buy alot of the items prefab. We then set the plans price at five percent of the prefab kit price. The materials/prefab parts price estimates were too low due to several reasons: (1) availability problems noted earlier, (2) handling/packaging costs of the many small items, (3) stampeding inflation of these type materials and (4) our obsolete price lists. Every item ended up costing more than our estimate, except the landing gear struts and they went up fifteen percent last month.

As a result, the current price for raw materials from the distributors is about $2,200.00 and about $3,400.00 if you elect to get as much as possible prefabricated. Plans price is now four percent of the prefab kit price. You can still build an EZ, for a materials cost of about $1,700.00 if you don't count tools, upholstery, and if you do a reasonable amount of scrounging for items like instruments, wheels, hardward, etc. Almost daily we hear from individuals who have found A - 75 and C-85 engines for $1,000.00 to $1,500.00 with lots of hours remaining. So the $3,000.00 airplane is not impossible, just improbable! We have about $5,800.00 in N4EZ, including the O-200 and a NavCom.

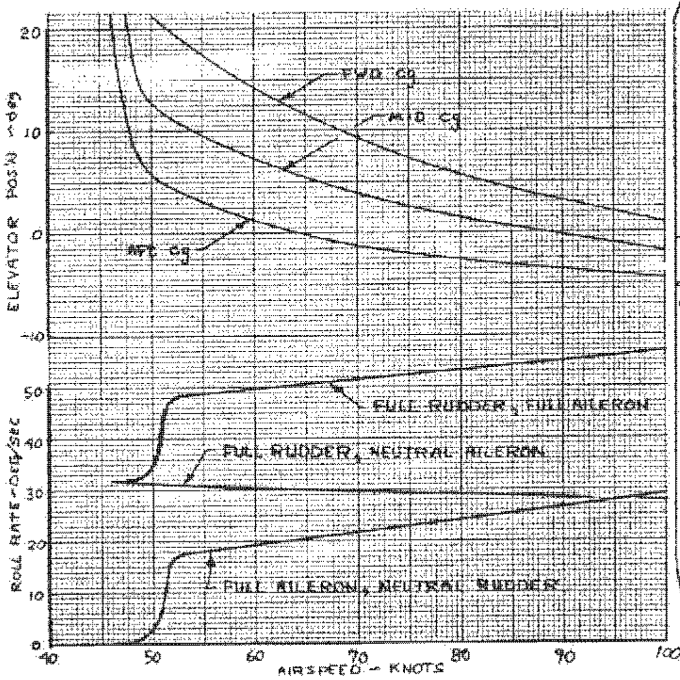
VARIEZE PARTS WEIGHTS

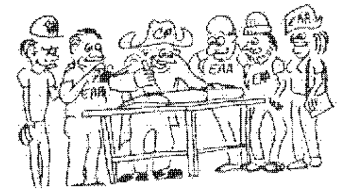
The following are average weights for items constructed from the VariEze plans:

CANARD (chapter 4)	16.7 lb.
Both elevons with weights	6.3 lb.
Each wing with fitting	34.0 lb.

TEST DATA

The following flight test data from VariEze N4EZ are presented for those interested. We will attempt to have a tidbit of this type in every newsletter





VARIEZE CONSTRUCTION HINTS

In general, builders acceptance of the construction methods has been excellent. We have received very little feed-back from anyone who felt that the building skill requirements were too high. Construction problems have been in two categories: (1) failure to follow or read the instructions in the plans, (2) errors or unclear areas in the plans. Category No. (1) will always be with us and can be avoided by following all the information in the plans carefully. Category No. (2) plans errors, are being cleared up due to the excellent feedback we receive from builders who contact us to suggest improvements.

Problem: The hot wire variable control shown in the plans is not only expensive, but has been discontinued by the supplier. The hot wire control can be any power source (AC or DC) capable of six amps (for .041 wire) or four amps (for .032 wire) and adjustable from about ten to eighteen volts. The following information lists several low cost units, and one which works great that you can build for about one dollar!

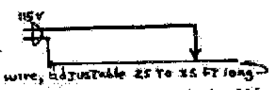
(1) Anderson Engineering Co.
2216 Foggy Bottom Road
Florissant, MO 63031
Kit # AS - 1 $17.99

This is an excellent control with an easily adjustable current up to eight amps.

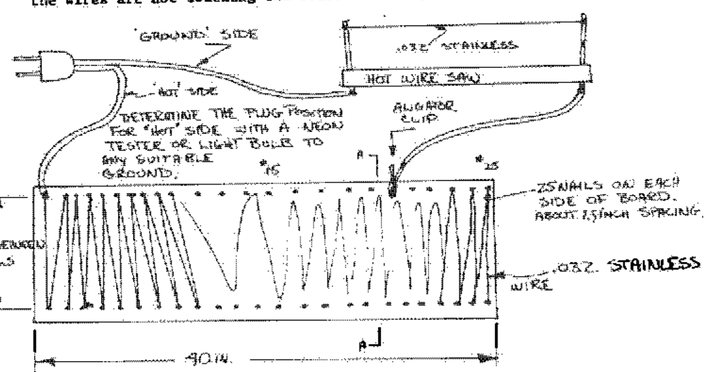
(2) Most model train transformers are capable of powering a hot wire of .025 or .032 dia. stainless steel.

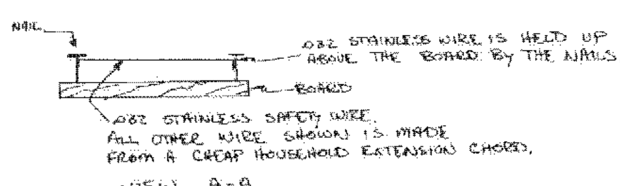
(3) A G.E. # OI - 61 ULO light dimmer (600 watt) control (about $5.00 in electrical supply houses) will power a .032 dia. hot wire. The control is quite sensitive and uses very small adjustments in the lower range of the dimmers range.

(4) The following schematic is all that is required to heat a hot wire using normal 115 - Volt house current.



Of course, a 30-foot hot wire is alittle hard to handle, and the 115 - Volt can give you a good jolt. So using the same principle you can make up the control as follows, using a 1 x 12 board, some wire (made from an extension cord), some nails, .032 stainless safety wire and an alligator clip. The wire is strung across 50 nails as shown, positioned up above the wood board. The alligator clip is adjustable from the 15th to the 25th nail to control wire temperature. Cover the 1st through 15th nails to avoid shock. The wire is hottest with the clip moved closest to the 15th nail. Be sure the wires are not touching the board. This system demands about 400 watts.





Regardless of what control you are using, be sure to set the temperature as instructed in the plans, one-inch cut every four to six seconds with very light pressure.

The paper mixing cups can be reused, even with a large amount of hardened epoxy in them - just be sure to balance your scale to level before adding epoxy and hardener.

If you need to estimate the thickness of glass buildup for a paticular layup, use the following values: BID = 0.013 inches-per-ply. UND = 0.009.

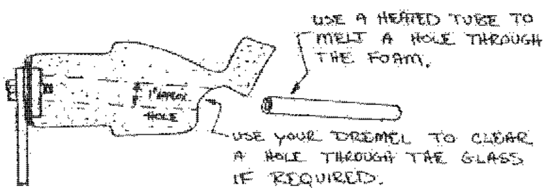
When mounting the template drawings for the wing foam cores, use a straightedge to assure that the level lines are straight. If you line them up referring only to the vertical lines, it is easy to get the rib crooked. A good spray paper adhesive like 3M-76 prevents the wrinkling caused by water-base glues.

Some builders have noted the full size center section spar pattern is about 0.1" shorter than the length indicated by the B.L. numbers. This is caused by an inaccuracy in the reproduction process and is small enough to be ignored.

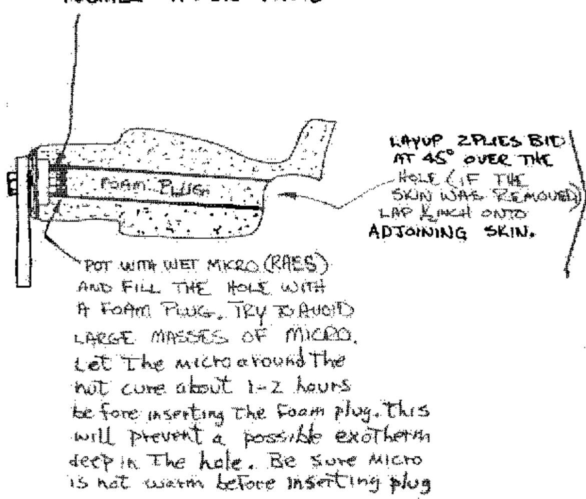
When tacking the large blocks together for the wing cores, some builders have had the five-minute leak down in the joint far enough to hang up the hot wire. This can be avoided by laying a stick of wood across the joint and applying the five-minute to the stick, well away from the foam joint.

Be sure you are checking the temperature of your immediate work area with a thermometer. If you want to slow the cure a little, a fan directed at the part will help.

Important! Some builders have indicated that they inadvertently drilled into the tapped metal insert for the canard lift tabs. We have given them the following instructions to install nuts on the inserts. Also, if you are not positive that you have good full threads on your inserts you should follow this procedure, which can be done even if the canard is completed.



INSTALL AN 316-4 NUTS



Note: The correction in the next section adds nutplates on the insert. If you have not installed the canard inserts yet (chapter 4, step 2), use the following procedure: line up the insert with the lift tab. Clamp together and drill the three 1/4-inch holes. Mark the inserts and tabs (top, front, right) so they don't get flipped over or reversed. Mount a K1000-4 nutplate behind each hole. Fill the nutplate and hole in the insert with silicone rubber (GE or Dow silicone bathtub caulk). This keeps epoxy and micro out of the threads when the insert is installed. Let the silicone dry 24 hours before installing the inserts. Now install the inserts as shown in the plans. After the step 2 cure, follow this procedure to drill the glass pad: make a stop for your 1/4-inch drill to avoid the possibility of the drill slipping into the nutplate. Drill the center hole only. Install the center bolt and lift tab. Carefully line up the tab and using the tab as a drill guide, drill the other holes. Remove the bolt, prepare both surfaces for bond and install the three bolts and tab with wet flox. The bolts will push the silicone back on installation. The best quality holes in the glass pad can be obtained if the step 2 cure is allowed to cure two to three days before drilling. An alternate method is to use the plans procedure, but substitute 1/4-inch steel for the 1/8-inch aluminum inserts.

When routing the holes for the VECS3 brackets do not gouge into the spar cap. The bolts must be removed to install the VECS3's. One builder routed the hole forward to allow the VECS3's to rotate into the notch, and in doing so, removed 1/3 of the spar cap! He had to replace his spar cap, full span.

Be sure the elevon slot in the canard is correct and true before skinning the canard bottom. Warps or high places may limit up-elevon travel.

When slicing the cross-fibers during the spar folding layup, use a new sharp razor blade. Make a light pass over the fold with the blade held as shown. Then use your brush to stipple the bubble down. Do not stroke the brush on the surface, all stippling is done as a vertical stab at the surface. This vertical stabbing motion is the majority of work in building an EZ. Brushing on resin builds up weight. Adding a little resin in a vertical stabbing motion is much better. If proper stippling is done, very little, if any, squeegeeing is needed.

Shelf life of RAE is two years unopened or one year after opening container. Both are for storage at room temperature out of sunlight. Do not store urethane foam in sunlight.

Do not be concerned that the elevon template is thicker than the elevon core. This accounts for the normal reduction in core size due to 'burn down' in the hot wire cutting. Excess can be trimmed before skinning. Check the fit of the CS2 brackets before glassing the bottom. They must line up well to allow the elevon to rotate smoothly without binding or stressing the VECS3 brackets.

We understand there is a wide range in sensitivities of bubbles in levels, ie., 1/2-bubble in one level may be twice the angle as 1/2-bubble in another. Be as precise as possible in setting wing twist and relative incidence. The relative incidence measured at the mid-span point must be within 0.1 inch over the length of a two-foot level. Do not reverse the level when checking right to left wings - this allows level inaccuracies to effect relative incidences. There is no room to be sloppy here; the twist and incidence of the wings must be set accurately.

A couple builders have reported that the glass build up on the wing fittings has been too high, such that even without the tolerance pads, the last ply is higher than the WA8 tongue (page 6 - 8). This is due to one or both of the following: (1) Inadequate stippling/squeegeeing on the pad/spar/skin layup causing anoverly wet, thick layup. (2) The Brock wing fittings have a WA3 tongue which is about .015 undersize due to a machining operation. This is equal to one ply of BID. Thus, we recommend that if you are using the Brock fittings, you reduce the pad by one ply and carefully squeegee during the layup. If you do come up high, do not cut away the skin, it must be continuous under the wing fitting. Make an aluminum spacer from some aluminum sheet and install it between WA3 and WA1 to fill the gap caused by a high layup. A high layup due to excess epoxy can be lowered by applying pressure on the top plate if the layup has not started to cure. This is possible if the layup is done below 75°f and with enough people so it can be completed within three hours. Never attempt any layup below 60°f, since the higher viscosity of the resin will make it more difficult to wet out the cloth. A good quality layup is difficult to achieve below 65°f.

A preferred method to potting the electrical wires in the wings is to install a conduit, then push the wires thru later when needed. The conduit can be thin-wall alum or plastic tube, 1/4 or 5/16 dia. Only two #18 wires are required per wing, since strobes should be mounted on the fuselage (one on top behind canopy and one on the bottom near the nose wheelwell).

Formica scraps or masonite make excellent material for templates.

Do not over tighten fasteners. Correct torque valves are #10 = 20 in lb., 1/4 = 60 in lb., 5/16 = 100 in lb.

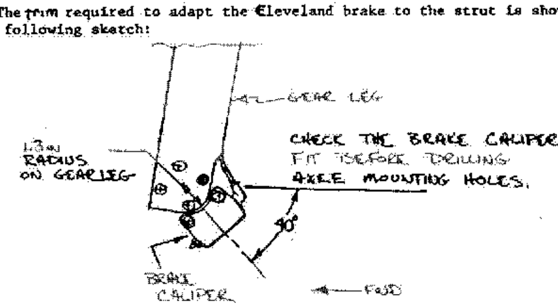
Drill a small hole through two 1-inch lengths of 1/2-inch diameter dowell and thread them onto the hot wire. This allows you to grab the wire immediately adjacent to the template for better control during hot wire cutting. Remember, the wire must be as tight as possible and speed must be slow around the leading edge to avoid lag undercuts. A leading edge undercut as much as 1/8 inch is acceptable and can be trued up with a long sanding block after the core is jigged.

Never make a glass layup over a core that is not straight and smooth. The glass panel cannot take the loads if it has bumps, depressions, steps, etc., in excess of the allowable values. Always check your core shape and size with the section drawings in the plans to assure they are formed and aligned properly before laying glass over them.

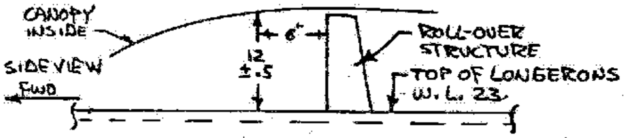
The main gear leg as received from Jiran looks twisted. This is due to the combination of the forward sweep and camber angle. If you want to check the toe-in before mounting the gear, set it upright with the end leading edges 4 inches forward of the center leading edge. Check the toe-in on a horizontal plane. It should be slightly toed in, but not more than 2 degrees. Adjustments can be made with a coarse sanding block before mounting the axles. Make the final adjustment after the gear is mounted.

Microspheres can be put in a large spice shaker for convenient dispensing.

The trim required to adapt the Cleveland brake to the strut is shown in the following sketch:

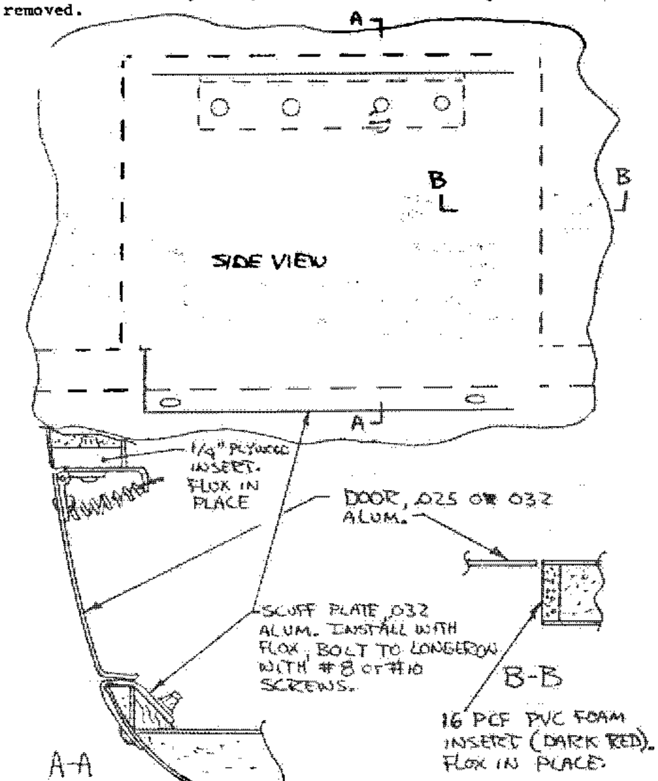


The dimension shown should be checked on the canopy when jigging it to the blocks on the fuselage (top of Page 22-2). Adjust the forward blocks if required, to attain the 12-inch height shown. In no case should this dimension be less than 11.5 inch. This would impair forward/downward visibility during climb and landing. This dimension cannot be determined by measuring the canopy as received from Cowley. The canopy is blown into a frame that is 20 inches wide at the front and 19 inch wide at the rear. The canopy is then bent inward to a smaller width when it rests on the blocks. This causes its height to increase in the center. Do not attempt to bend the canopy in until it is trimmed as shown in chapter 22.



Refer to the following drawings for installation of the kick-in step. Refer to the Owners Manual for details on use of the step.

First, cut a 4-1/2" long by 3-1/4" high hole in the fuselage side just above the lower longeron and just aft or forward of the seat belt mount. Fit the side pieces (16-lb PVC) and top piece (1/4" ply) into place after removing enough foam. A short piece of piano hinge is bolted to the plywood insert and riveted (1/8" pop rivets) to the door. A small compression spring, (attached on each end to the door and to an aluminum bracket with safety wire) closes the door when your foot is removed.



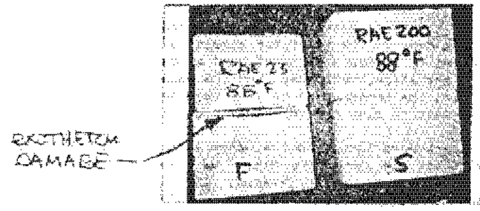
The following is a simple way to check the pot life of your epoxy and give you a feeling for the importance of mixing batches of epoxy only as you need them. Be sure your resin and hardener are at 75 deg F. Mix about 5 oz of epoxy, stir well and leave the cup undisturbed at 75 deg F. Be sure you use the supplied 8 oz cup. The fast epoxy should exotherm, reaching a solid block in about 30 to 40 minutes. Slow epoxy should be solid in about 60 to 90 minutes.

WING FITTINGS- Before you bond the fitting permanently to your wing-spar foam core(chapter 6, step 3), trial fit the whole wing foam core(with the fitting) in the jig. The fitting should fit flush with the inboard edge of the foam core. Check the positioning of the spar core carefully and make sure that the spar trough top and bottom is deep enough to accomodate the spar cap layup. Use the section views of the completed wing on pages 6-18 through 6-21. Make sure that the fitting is on the spar foam core straight and not cocked off to one side vertically or horizontally.

Exotherm foam damage - care must be taken to avoid heavy buildups of epoxy/micro down inside a joint that is insulated by foam, such as on the assembly of the wing cores and on the winglet mounting. The gap to be filled by micro when assembling any foam cores should not be thicker than 1/16 inch. If you try to fill a gap greater than 0.1 inch you will be adding excessive weight and, more important, the large mass of epoxy-micro, insulated by the foam, can exotherm. Heat resulting from exotherm can be as high as 450 degrees F, which will melt away the foam locally and destroy the joint. On the winglet attachment (chapter 24, step 3), wait about an hour before doing the last paragraph on page 24-2. This allows the inside layup to partially cure before installing the extra micro and green block. Feel the inside layup before installing the block to assure it did not get hot due to exotherm.

Any time an exotherm is suspected, by an expansion of the epoxy at the surface or by the epoxy at the surface getting hot during cure, the joint must be inspected for exotherm damage.

It is good practice to not only keep the gaps small, but to do large block assembly below 70 degrees F. Always use RAES on core assembly or any large-mass potting; it was specifically formulated to eliminate an exotherm. Do not substitute RAEF. The photo shows a comparison of F and S joints. Note the form damage caused by the exotherm deep in the F joint.



WORKMANSHIP AND QUALITY CONTROL

In section I we gave you detailed information on specific defects that you may find in your work and how to repair them if necessary. We went into details there and don't need to repeat them here, but it does seem appropriate to make a few comments of a more general nature on workmanship. There is no substitute for good workmanship, and no excuse for poor workmanship. We've made an effort at making the materials and techniques as easy as possible for the beginner to do well, but nothing as complex as an airplane will ever be completely idiot-proof. All of you will make some minor mistakes in the process of building your airplane and this is perfectly normal. There are also, unfortunately, a few of you who will make serious mistakes and lots of them. All of you must remember that you are your only quality control and nobody else can do it for you. If you have questionable parts you are burdened with the decision to scrap them or use them. If you are lucky enough to have another builder nearby let him look your project over and respect his opinion of your workmanship. If you find that another builder in your area is doing poor work, please have the courage to tell him so. If we help police each other our safety record will improve and we'll be able to preserve our lenient rules. Sometimes it is hard for us to admit to ourselves that an expensive part is really junk and a second opinion may help us to decide.

Remember, a wrinkle, depression, or bump in the layup which is greater than 1/16 inch high (or low) and which is more than 20% of the chord length or 20% of the spar chord is not acceptable and requires repair. A depression can generally be repaired by filling with flox to level and laying over the entire depression the amount of glass that is underneath, lapping outside the depression a distance equal to one inch per ply. Be sure you don't layup a depression or bump in the thick main spar caps. The transition of the spar caps into the wing fittings must be smooth and without joggles. The above applies only to the flying surfaces. The fuselage and fuel tanks can have relatively large depressions or bumps without effecting structural safety.

Be aware during the finishing process that you are sanding on your structure. If a bump or corner exists it is very easy to sand through more than one ply. Removal of more than one ply in the following areas requires repair: wing, canard, winglet (more than 20% of chord) and center section spar corners or shear web (be especially careful sanding near the wing fittings).

VARIEZE PLANS CORRECTIONS/CLARIFICATIONS

We've got a lot of corrections this issue, because there are already several people who have built most of the airplane from original--edition plans, all since the last newsletter. Most of you already have most of these changes since they were sent back with license agreements and included with shipments of materials from the distributors. Several of you will also be working with original--edition plans for the last half of the project between now and January when the next newsletter is due. So, keep your eyes open for errors/ommissions in the plans and keep us informed if you find them. Those of you who are working on the second-half (chapter 15 on) between now and January should send us a self-addressed stamped envelope. If we find important changes before January we will make copies, stuff your envelopes and send them out immediately. Be sure to mark "PLANS CHANGES" on the outside of your S.A.S.E. Do not send the envelope unless you are actually working past chapter 15.

Now - grab a pencil and make the following corrections in your plans.

PAGE/ITEM	
5 - 4, Step 6	Clarification - The notch in the canard to accept the mass balance weight consists of removing the bottom skin and the foam. Do not remove the top skin.
9 - 2, BKHD	16.5 dimension should be 18.1. If you have already made it 16.5, do not reject it. The space can be filled with a 3-ply BID tape after chapter 11.

? - 5, Balance check — 20 to 30 should be 10 to 25 deg.

1? - 1, Bracket — 1.75 dimension can be revised to 1.6 to allow this part to be fabricated from the 2 inch angle supplied by Aircraft Spruce and Wic

16 - 1, Belcrank — Lower hole should be # 12 drill. If you have already drilled it out to 1/4 inch, use a 1/4 inch bolt when mounting the cable in chapter 19.

17 - 1, F.S. — F.S. 2.0 should be F.S. 2.15.

17 - 8, View AA — VECS 13 should be NG 13.

4 - 3, 4 - 16, Inserts — Install nutplates, three per insert over holes drilled in place with lift tabs, see 'building hints' in this newsletter.

2 - 2, Hardware — Add six K1000-3 nutplates and 12 AN426 - AD3-5 rivets.

2 - 3, Chapter 10 — 9.6 should be 0.6.

5 - 6, VECS2 — Only one of the two aft rivets are required. See page 5 - 5.

5 - 3, Center — Trailing - edge micro fill is incorrectly shown on the top of the elevon. Should be on bottom as shown on the top of the page. Ditto for page 5 - 6.

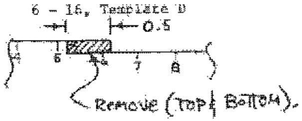
5 - 5, 5 - 6, Weights — CS11 lead weight size is 0.6 x 0.8 x 2.0. CS10 is full size as shown, 0.8 wide.

6 - 11, 2 - 2 and 2 - 3 — AN 525 - 416R - 16 should be AN 525 - 416R - 14. If you have received - 16 screws from Aircraft Spruce and Wicks, return them for -14 screws.

16 - 2, Page nos. — The missing page numbers refer to the drawings on this page (16-2).

7 - 1, 7 - 2 Winglet — Clarification: The dimensions at the top of page 7 - 1 are to rough out a block to use for the winglet. Trim the block to the dimensions in the center of the page and on page 7 - 2 to obtain the correct winglet size. 103 deg should be 103.7 deg.

6 - 16, Template D



The notch which extends from talking number 11 to about 6.2 should extend another 1/2 inch to talking number 5.2. This allows the wing fitting to slide in another 1/2 inch to its correct position on the wing.

2 - 2, 2 - 3, UND — Add eight yards to the total amount of UND required. Most of the shortage was due to an error in the chapter 4 estimate.

3 - 9, Step 6 — 'Resin' should be 'epoxy'. Also page three - ten step 7, and page three - seventeen. Plain resin is never used for anything.

2 - 2, Nuts — 'AN 316 - 3' should be 'AN 315 - 3'. Distributors made this correction before shipping any hardware.

2 - 2, Tubing — List shows two pieces, seven feet long for 1 1/4-inch tube. To avoid large cut-off waste, distributors are shipping one piece 66 inches long and one piece 84 inches long.

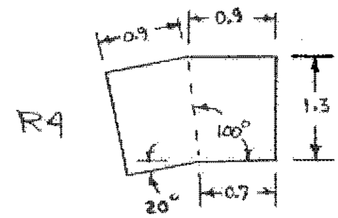
2 - 2, Foam — Urethane green foam (Uthane 200) is no longer being produced. Distributors are now stocking Uthane 190 or Uthane 210 which is a light tan foam. Do not substitute trymer or 9005.

6 - 5, Pads — The 4" x 6" pads should be 2-1/2" x 6". The pads on 6 - 7 and 6 - 11 are correct. They can extend beyond the fitting. The sketches on page 6 - 4 do not appear to show the wing fitting at its 25-degree angle. This is shown correctly in the sketches and photos on page 6 - 5.

8 - 5, Pads — '22 plies' should be '40 plies' and '25 plies' should be '46 plies'.

6 - 8, Spar cap — Clarification: The photo at the top shows the cap extending out onto the outboard core farther than it actually does. The photo was taken for the top layup (step 8), in which the cap is longer.

7 - 3, R4 Angle — Substitute the following pattern for the R4 angles. Two are bent up, two are bent down.



22 - 4, Top sketch — Arrow from 'plexiglass' is incorrect.

5 - 5, CS3/CS11 — The CS11 weight interferes with the CS3 bracket before full trailing-edge down travel on the right elevon; either mount the CS11 weight out further on CS12, or take your Dremmel and grind some material from CS3 and CS11 to allow full travel. The CS11 weight should strike the bottom of the canard about the same time as the CS10 weight strikes the top skin inside its cut out.

Owners Manual — Owners Manual page 40, top. Add 'recheck torque of prop bolts after first run, after 10 hours and each 50 hours thereafter'. Also the table on page 33 (sample weight and balance data) is incorrect. Substitute the following. The most desirable empty cg position is at F.S. 110.

ITEM	GROSS	TARE	NET	ARM	MOMENT
RT M.	275	0	275	108.0	29,700
LT M.	276	0	276	108.0	29,808
NOSE	8	-1	7	17.0	119
BALLAST	-25		-25	40.0	-1000
TOTAL			533	110.0	58627

1 - 1, 1st paragraph — Some early sets of plans omitted page count. Add 153 and 9.

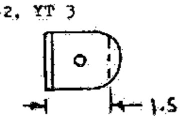
5 - 6, CS2 — Material call-out omitted. This is not a VariEze part to make. If you want to homebuild it, use the full size drawing on page 5 - 6. The pivot with bushing must be 0.1 to 0.15" forward of the centerline of the elevon tube when the bottom of the elevon is level. The flange is 0.6 wide. Use 2024-0 0.63 thick and heat treat to T3. When mounting CS2 to the tube a washer may be required under the nut on the one that does not sit on the canard glass skins.

3 - 11, Glass taper — Slope of taper shown as 2-1/2 inches per ply should be 1-inch per ply (2 1/2 c.m.).

5 - 6, CS12, CS 3 — Material callout omitted. Fabricate from .125 thick 2024-T3. Full size pattern shown.

2 - 2, MISC — Nyloseal tubing (46 ft.) should be 3/16" x .025 Polypenco Nylaflow tubing (46 ft.)

20 - 2, YT 3 — The drawing shows this piece 1.7" long on one leg. Revise the drawing to 1.5" so the piece can be made from the supplied extrusion angle.

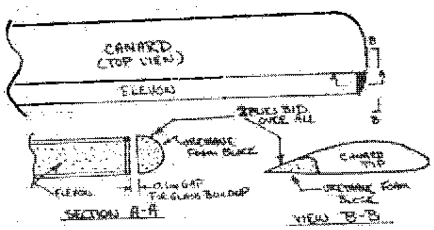


6-17, Wing Fittings

Material callouts omitted. All material except WA4 is 2024-T3. WA3 tongue is 3/8 inch plate, milled .003 thinner than WA5 to provide clearance. WA2 and WA1 plates are 1/8 thick. WA6 plates are 0.063 thick. WA7 tubes are 1X.035. Overall height to outside of WA1 plates is 6.0 inch. Scale other dimensions. WA4 pins are 4130 heat treat to 120KSI. Taper is 10 degree included angle. Top pins are drilled 1/4 inch. Bottom pins are tapped 1/4 X 28. The #10-32 tapped holes in WA3 should be only .35 deep. Use bottoming tap. Long bolt may have to be -51 length depending on tolerance accumulation, or an SAE grade 8 bolt can be substituted which has a longer thread length.

5-6, Tip Fairing

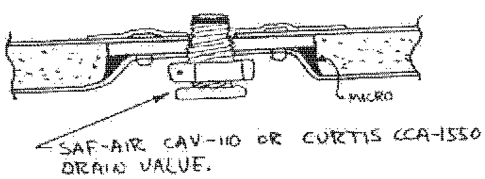
The small cosmetic fairing at each canard tip is not shown on the plans. This fairing is attached to the canard and fills the one-inch void outboard of the elevons. Shape is not critical, just be sure it doesn't rub on the elevons. See sketch below.



21-4, Step 6

While your composite fuel tanks are less susceptible to condensation than a metal tank, they can still be contaminated with water from the fuel truck. The low point water drain (section IIA) will drain water only if the aircraft is in a level attitude. Since the airplane parks nose down it is recommended that drains be installed in the forward tip of the TANKS as shown. It is preferred to install them during step 6, however, they can be installed (without rivets) after the tanks are closed out.

AFTER INSIDE LAYUP CURES, REMOVE FOAM & INSTALL 1.5" DIA 1/8" THICK ALUM PLATE WITH WET FLOX & FOUR POP RIVETS. GLASS 1 PLY BID OVER RIVETS. DRILL & TAP 1/8-27 NPT. PLUG TO AVOID CONTAMINATING TANK. GLASS OUTSIDE AS SHOWN.



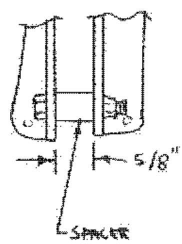
One builder interpreted the cross-hatched lines on the five shear web plies on page 4-4, as being individual strips of cloth! The shear web is, of course, five pieces sized as shown; the cross-hatched lines just verify fiber orientation.

PUBLICATIONS

There is an excellent VariEze article in the November "Private Pilot" magazine, which covers some previously unpublished information on the program.

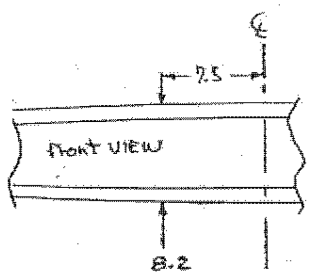
The October "Sport Aviation" has some VariEze photos and a writeup on our Oshkosh trip. "Sport Aviation" is the official magazine of EAA, and can only be obtained through membership with EAA: Experimental Aircraft Ass., Inc., PO Bx 229, Hales Corners, Wi 53130.

A5 Gearmount



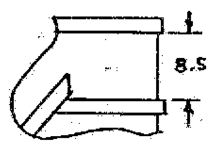
The landing gear mount extrusions are shown with incorrect separation between pairs. Both pairs (per side) should be separated 0.625 (5/8 inch). When installing the extrusions on page 10-5 (step 4), bolt the individual pairs together with a 5/8 inch spacer between them before drilling them into the fuselage sides, to assure alignment for the gear bolt holes. When installing the gear on the fuselage (page 18-3) if there is space left over in front or back of the tabs, fill this with an AN 970-4 washer or an aluminum shim.

8-2 Spar size



Due to the spar front and back pattern being slightly oversize and to the possibility of growth in height in assembly of the center-section spar, its thickness should be checked after step 2. This is necessary to assure fit to the fuselage longerons and to the engine mount. Locate B.L. 7.5 on either side of the centerline. The height top to bottom should be 8.2 inches at B.L. 7.5. Sand the top and bottom surfaces equally to attain the 8.2 dimension, fairing smoothly into the outside contour at about B.L. 23. Don't make waves, gouges, or notches in the foam to assure that the spar caps will be laid up straight.

10-2 Longerons



The distance between the bottom of the top longeron and the top of the short longeron is 8.5 inch. This is not clearly shown on page 10-2, but can be determined from A5.

We have been advised by FAA that our registration numbers must be orizontal, not vertical as they have been. The numbers will have to get maller to stay on the winglet but I guess that's ok. Strike the reference o vertical format on page 1 - 5 of section I.

WEIGHT HURTS! KEEP IT LIGHT.

6-1 and 6-2, Step 1

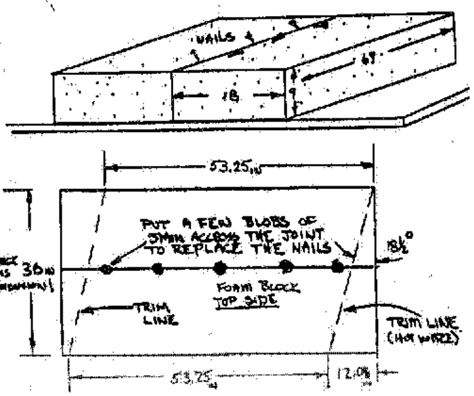
Step 1, wing foam core cutting has several obvious errors - Vari-Eze wings sweep aft not forward! Replace step 1 with the revision shown here. You will cut 4 cores in the following sequence: RT OTBD, LT OTBD, RT INBD, and LT INBD. Each of the large blocks has one left and one right core. On page 6-12 through 6-15 are patterns for A, B, and C. The flip sides are X, Y, and Z, respectively.

STEP 1

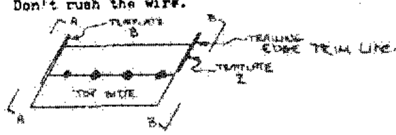
HOT WIRE CUTTING THE WING FOAM CORES

This step will take about two hours. You need an assistant for hot wire cutting. First make the three airfoil templates A, B, C and the two spar templates D, shown on pages 6-12 thru 6-16 from plywood or sheet metal. While you're doing woodwork, make the three jig blocks E, F, and G shown on pages 6-12 thru 6-15 from ¼ plywood. Lay two of the 9x18x67 blue foam blocks out on your work bench and nail together as shown. Remember that templates X, Y, and Z are the flip sides of A, B, and C.

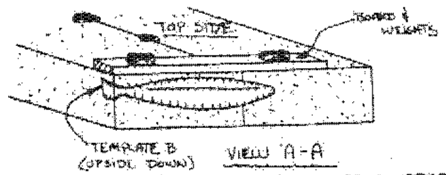
TRIMMING THE FOAM BLOCK SETS THE PLANFORM OF YOUR WING.



Carefully hot wire trim the blocks to the dimensions shown. Position the templates for the outboard right wing core as shown. Careful positioning is required so that enough foam is left for the inboard wing and winglet cores.
Cut the core. Go slowly around the leading edge; pause at the marks. Don't rush the wire.

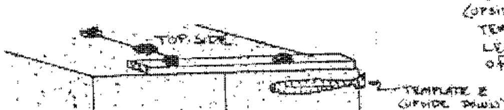


AFTER TRIMMING
FOAM SETUP FOR OUTBOARD RIGHT HAND FOAM CORE



VIEW A-A

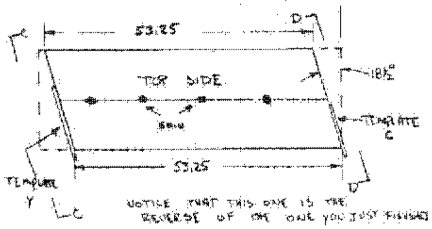
TEMPLATE GOES IN THE EXTREME UPPER LEFT CORNER. Trim line set on edge of foam block.



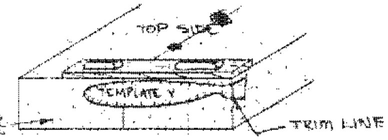
VIEW B-B

PAGE 6-1 REVISED

Pull the templates off and set the whole block aside. Get the other blocks, assemble and trim them as shown.
Align and level templates Y and C as shown (Y is the flip side of B, Z is the flip side of C). Cut the LEFT outboard foam core. Now, modify template B and Y by carving out the spar trough as marked on the template.



VIEW D-D

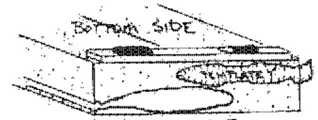


VIEW C-C

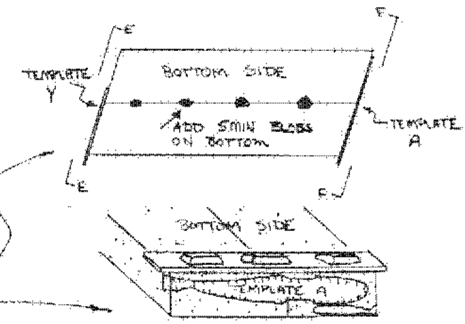
THESE SKETCHES SHOW THE FOAM SETUP FOR HOT WIRING THE LEFT OUTBOARD WING CORE

TEMPLATE MODIFICATION

Flip the foam block over and position template A and Y as shown. Cut the inboard right foam core.



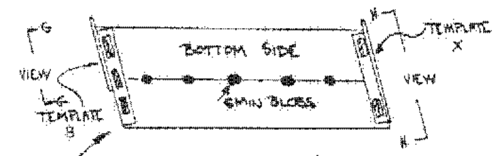
VIEW E-E



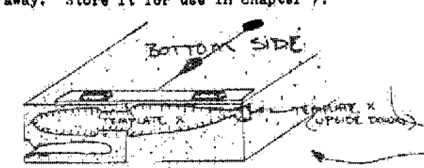
VIEW F-F

THESE SKETCHES SHOW THE FOAM SETUP FOR HOTWIRING THE RIGHT INBOARD CORE

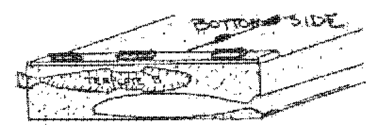
Now, set the finished cores and trimming foam block aside and put the rest foam block back on the table. Locate the X and B templates as shown.
Now, cut the inboard left-hand core. Go slowly around the leading edge, pause where indicated. Before you remove the foam cores from the block, mark the waterline on each with a ball-point pen.



Don't throw the remaining block of foam away. Store it for use in chapter 7.



VIEW H-H



VIEW G-G

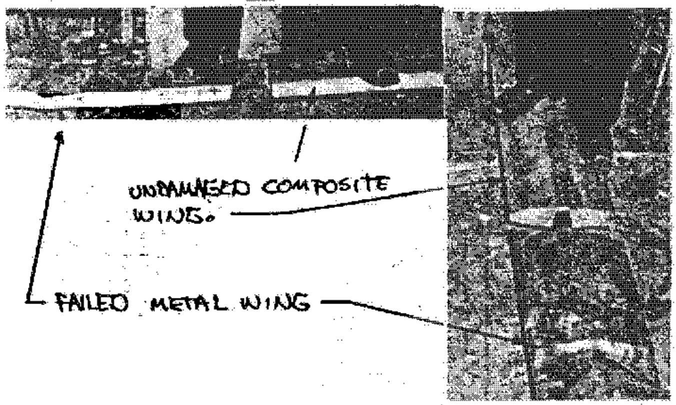
THESE SKETCHES SHOW THE FOAM SETUP FOR HOT WIRING THE LEFT INBOARD WING CORE

PAGE 6-2 REVISED

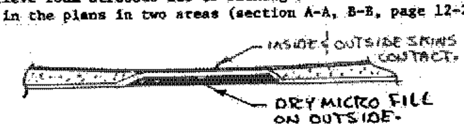
NOTE: CHECK VERTICAL PLACEMENT OF TEMPLATES TO ALLOW CORES TO BE CUT OUT OF THE BLOCK WITHOUT INTERFERENCE.

COMPOSITE STRUCTURE

The photos show what's left of a sample we took to Oshkosh as a comparison between our composite and a typical all-aluminum structure. The sample consists of an all-aluminum wing, which was originally built for the canard of the Mini-Viggen (this aircraft was never completed). On the end of its stub spar we built a glass/foam/glass structure with core, spar and skin similar to the VariEze canard. We designed the composite side to be equal in weight; it came out only slightly heavier. At Oshkosh we placed a block of foam under each wingtip and asked people to walk on the combined structure. The metal wing failed at mid-span the second day. The structure was walked on during the remaining part of the show and then shipped via motor freight to California with only a cardboard cover. As you can see in the photo the metal wing has severe permanent damage in its skin surface, trailing edge spar and ribs. Under load its contour looks more like a wrinkled paper bag than an airfoil. The composite side is undamaged. Even the Texas boots on the trailing edge did not cause failure or distortion of contour. Of course, we do not recommend you walk on your aircraft wing.



A breakdown of the sandwich core in an area on the side of the fuselage on N4EZ occurred and was noticed on the trip to Oshkosh. At first we thought it was a skin delamination, since it looked like the skin had pulled away from the foam over an area of about 3" X 6" on the fuselage side adjacent to the throttle. Closer inspection revealed that the foam had deteriorated in the local area, rather than the skin pulling away. This was in an area where the foam was only about 0.1 inch thick due to the inside contouring around the throttle. So, with only a thin core in this area, the sandwich was not rigid. If you pushed hard on it it could flex, and thus over-stress and deteriorate the urethane foam. This area was repaired on-the-spot by drilling a hole at the top and bottom of the effected area and injecting epoxy in the bottom, allowing air to escape out the top hole until the void was full. This stiffened the originally flexable area and made it much stronger than before. The minimum core thickness on the plans over a wide enough area to allow flexing is 0.3 inch, so unless you beat on the skins you should not experience this problem. If you have over-contoured the inside skin such that you have a thin core over a wide area you can remove all foam over a small area as shown, before glassing the outsides, to relieve foam stresses due to flexing loads. This technique is already used in the plans in two areas (section A-A, B-B, page 12-2).

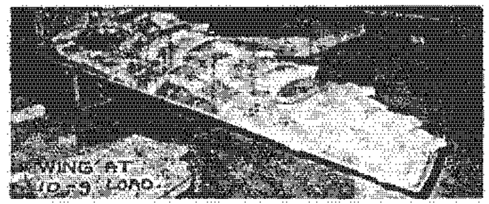


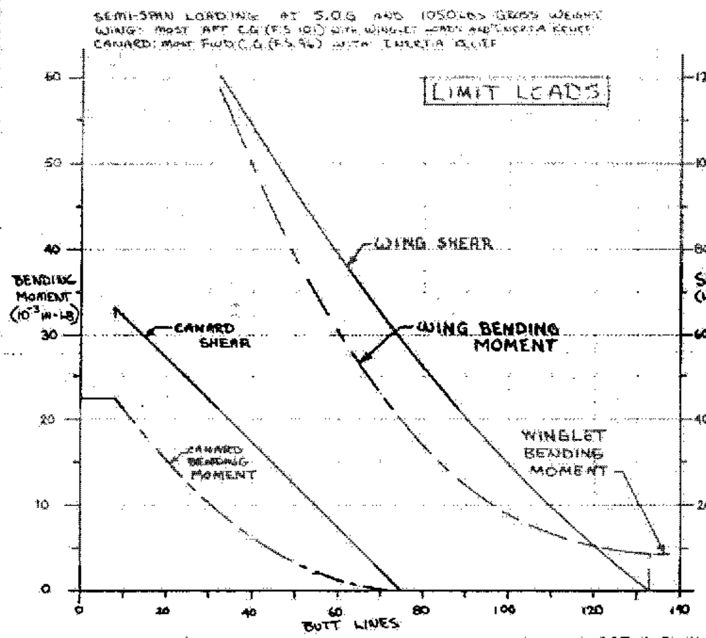
The Blue foam and PVC foams, due to their inherent elasticity are not as susceptible to fatigue as the urethane. We do not recommend any changes due to this experience, since they should not occur in an area or in a fashion to cause any dangerous structural weakness. Just don't beat on your airplane like we do to show its durability. Keep your eye out for any deterioration, which is detectable by skin flexibility or contour variances, and repair by injecting epoxy. A glue gun, available at any model hobby shop is ideal for this purpose. Above all, do not make substitutions in foam types. There are urethane foams on the market with only ½ the fatigue strength of the EZ Foam.

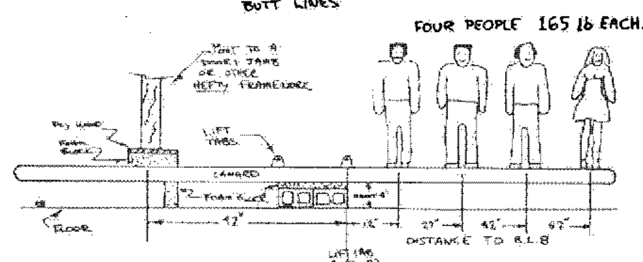
We get an occasional question on how the structure will behave at extremely low temperatures. The answer is we frankly do not know, but based on available information we do not expect cold temperature problems. The coldest N4EZ and N7EZ has been is minus 15 degrees C (in flight at altitude). The glass sailplane people are not aware of any cold-related problems. The flying surfaces, with all load-carrying structure at the surface are not as susceptible to thermal stress due to rapid temperature changes as are many other designs. According to materials specifications and the guidelines in the "Advanced Composite Design Guide" the structure should experience no adverse effects to below - 50 degrees F. There are several EZ's being built in Alaska. Any information they can add will be published in the "Canard Pusher." If you are concerned about a different environment (cold, humid, salty, etc.) in your area or anything unusual, you should conduct the appropriate tests to satisfy yourself of the adequacy of the product. It is, of course, impossible for us to provide all the answers, but we do our best to expose the airplane to as much testing as possible and have, and will continue to, publish any problems encountered and their solutions.

We have had a number of requests for loading data from individuals wanting to proof-load their surfaces, and from those seeking Foreign approval for the design. The accompanying data are the limit spanwise loads (5-g) and are for the worst-case cg conditions, aft cg for the wing and forward cg for the canard. Also shown is a convenient way to proof-load your canard, using a foam block and some friends. Don't do this by merely hanging it from the lift tabs. It must be supported (as on the fuselage) at the trailing edge to keep from bending the tabs. Also shown is our test of the complete wing and fitting, loaded to twice limit loading with shot bags. This load is equal to twelve 170-lb people.

While demonstrating limit loads can give you a great deal of confidence, it should in no way be a reason to accept a part with poor workmanship.







FAA COMPOSITE STRUCTURE INSPECTION

We have reprinted the inspection criteria that was distributed to the FAA GADO's, EMDO's and AEDO's in this newsletter for your information and in case your local inspector missed out on the distribution. You should contact your local inspector before you actually build much of your airplane. The sequence of inspections and at what items he wants to see are his own choice. Some of you early birds may find that you have the Feds looking over your shoulder pretty often until they get up to speed on the construction sequence. SEE PAGE 14 OF THIS NEWSLETTER.

In some places the local FAA inspectors have asked to see the wing shear web before assembly of the wing foam core. We don't recommend this because if the shear web layup is allowed to cure before assembly of the foam core it must be sanded dull for bonding later. The sanding process may damage the surface plies of glass, result in an inferior part to one wet bonded. If your local inspector insists on seeing the wing shear web, try to have him there to inspect it wet. If you can't arrange this, add an additional BID shear web ply full length on the fore and aft faces to be sanded after cure. Be super cautious that your shear web box isn't bowed while it cures.

FOREIGN BUILDERS

There is quite a bit of interest in the VariEze around the world and we have a few words of caution for potential overseas builders. Government regulations and limitations on homebuilts vary quite a bit from country to country. Please check with your local authorities before ordering plans, since we can't refund plans orders if you find out later that the VariEze is not approved for construction in your country or that materials are prohibitively costly or unavailable.

The shipping costs to some areas of the world are over $1300, making the costs prohibitive for many potential builders. We are looking into the availability of acceptable substitute materials. We have found that the foams are not available at all in some countries. One builder in Germany has reported success in substituting Rohacell for the 2 lb/ft^3 blue styrene foam, however, it's high moisture absorbtion makes it suspect. If you are searching for substitutes do not accept any material which has lower strength or other physical properties than the recommended materials shown as follows:

Blue Styrene: Dow Chemical Co. Brand F.B.
Styrofoam, 2 $\pm$ 0.2 lb/ft^3 density,
cell size 1.4 to 2.4 mm.

Green Urethane: Upjohn Chemical Co.
U-Thane 200 or
U-Thane 210 or
U-Thane 190

Ridgid P.V.C.: Conticell equivalent
densities are available in Europe.

ENGINES

0-200-A Pusher installation in N4EZ has a total of about 150-flight hours to date. There has been no measurable increase in crankshaft end play which would reflect thrust bearing wear. Everything looks good for the 0-200-A on the VariEze aircraft. Do not conclude from this that the 'A' model engine is suitable in other pusher aircraft. Look at your owners manual for the technical discussion on thrust loading.

A.C. BOYLE, chapter 40 Designee, and A & P rated mechanic has been kind enough to offer some suggestions to those of you who are overhauling or servicing small Continental engines.

If you are overhauling an A-65, convert it to A-75. The conversion is covered by Continental service bulletin M47-16, revised 9/25/68.

Install the 100 octane valve conversion when overhauling any of the small Continentals.

Pistons, rings, valves, valve guides, rocker arm busings, rocker arm pivot pins, and bosses on the cylinder heads should all meet new tolerances not service limits if you expect to get the full TBO.

Never have crankshaft grinding done by an automotive shop. Stick with an FAA approved regrind shop. The bearing journals on aircraft crankshafts have specific requirements that auto machine shops generally don't have the equipment to meet.

If you want to convert to slick 4000 series magnetos use slick kit #M2640 which gives the mags and hardware. Continental part #36066 drive gears are used with these magnetos.

Have your inspection (Magnaflux & Zyglo) and machine work (grinding and plating) done by a competent aircraft machine shop. Don't take chances with amateurs.

If you plan to store your newly overhauled engine over 90 days don't test run it until you're ready to put it in service. The combustion products from the run-in will cause corrosion internally. If long-term storage is planned, oil all internal surfaces on assembly, plug all openings (breather, oil pressure port, intake, and exhaust openings), and install desicant spark plugs.

Follow the service manual's recommended run-in procedure.

Regarding the use of 100LL fuel in the low compression small Continentals. If adequate (100 octane) valves are installed, plugs cleaned every 100 hr., and oil changed every 25 to 30 hours, no appreciable degradation of engine dependability should be experienced as a result of 100LL use.

VW ENGINES

We have been talking to a number of "high time" VW flyers over the last few months and the story we hear is generally one of woe and poverty. The message that we get, even from successful bug operators, isn't very enthusiastic. One high timer (800 hour) said that there were probably ten other guys who had suffered failures with VW's for each successful operator. He is using a Continental C-85 in his VariEze. Another bug operator we talked to said that in the 240 hours he was able to operate before failure, his VW cost him more dollars than a brand new 0-200 would have (at that time $3800), and he spent an hour with the cowling off for every hour he spent flying. The thing that scares us is that both of these gents are very competent engine mechanics with plenty of troubleshooting experience and a trained ear for problems before they get serious.

On the other hand, we talked to a group of small-bore VW operators (36-50 hp) who had excellent service in motor gliders with very little hassle. Unfortunately the 36 to 50-hp engines, are too small to power a VariEze. Our present conclusion has to be that we can't encourage the use of VW conversions in the VariEze yet. We say yet because a number of development programs are underway and eventually the big-bore bug may become an aircraft power plant, but don't hold your breath waiting. If we were to recommend a VW installation currently, we would expect to see a lot of unhappy builders, a high percentage of maintenance troubles, exessive costs, and possibly some accidents. Beyond basic engine durability the VW converters are faced with devising and supporting a service bulletin and airworthiness directive (AD) system to support the operator. Frankly, Continental and Lycoming would not have the success record that they do without the customer support effort in service and overhaul manuals, AD's, and service bulletins. We do understand that the Limbach engine does have a functioning AD system and is one of the more reliable VW's around. Unfortunately, these engines are more expensive and harder to get than the Continentals.

There are some of you who are qualified mechanics, experienced with both VW and aircraft engines, and you know that you can operate a VW engine safely and reliably. If you want to build your VariEze without waiting for section IIB and a full development program, you can use section IIA as a guide and develop your own installation details. Efforts to develop and refine the big bore VW's are underway. One of the manufactures will work on an Eze installation after demonstrating several hundred hours service in a Champ. We will monitor their efforts. If they prove successful and if they can provide adequate customer service, then we will publish section IIB. The earliest that this could happen is the summer of '77. We regret that IIB can't be published now but to do so would be an injustice to you, to EAA, and the accident record might jeopardize our lenient FAA rules. We will not accept orders for section IIB until a successful installation is developed. The VW installation we have in VariEze N7EZ does not have adequate reliability.

This is not to infer that the VW does not have its place in sport aviation. Its use can be justified in a low wingloading airplane such as a Volksplane or Pixie for recreational utility, and where a forced landing can always be successfully done. Those applications generally involve less than 50 flight hours per year and thus the cost per year for the first few years is quite economical.

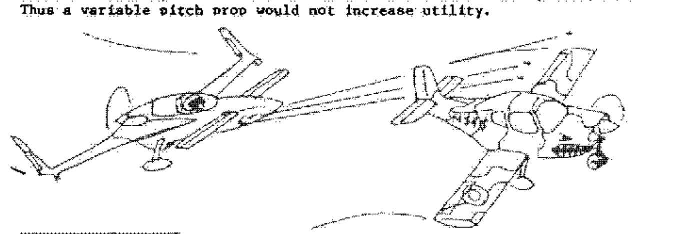
LYCOMING ENGINES

We've received a lot of flack over our selection of the Continental engines for the VariEze since most models have been out of production for years. The most common question is "How about the Lycoming engines?" and this is your answer: They are too heavy. The 0-290, 0-320, 0-340, and 0-360 engines are totally out of the question.

The 0-235 models could be used only with some strict limitations. The normally equipped 0-235 is 242 pounds which is much too heavy both structurally and from C.G. considerations. If the 0-235 is stripped (mags and carburetor only remaining) its weight can be reduced to 211 pounds which is marginal but can be lived with (as is the Continental 0-200 with alternator but no starter); the 0-235 has some advantages in lower cost, and it is available in a 100 octane-burning version. We haven't flown an 0-235 installation and it may not work out successfully, so don't rush out and sell your Continentals. Even if the 0-235 works ok, you would be restricted to no electrical system. A Vari-Eze program on the 0-235 is underway and it could become section IIC, but the earliest that this could happen would be next summer. The 0-235 produces too much horsepower and would have to be limited to lower cruise power settings. If you're unhappy about the available engines as we are, speak out! Write to your Congressmen (to Lycoming and Continental) and tell them to get on the stick and produce an 80 hp, 160 pound, under $3000 engine. The technology is available and if enough interest is generated, maybe we'll get some action. Get your friends to write and show the manufacturers how big the market is.

VARIABLE PITCH PROPELLERS

We haven't gotten too many requests for variable pitch/constant speed/adjustable props from our builders which is a tribute to their good sense and intelligence. However, for those few who have asked about them this is why we are down on them: safety, cost, weight, and maintenance. First, it is a very definite risk to install a variable pitch prop on a pusher aircraft. The development of a variable pusher prop for the VariEze could easily run hundreds of thousands of dollars and still be a failure. The cost of a proven variable prop, even if one were available would be over a thousand dollars each. The lightest controllable prop would weigh about 25 pounds which would create a CG problem requiring ballast, further increasing the weight growth. The maintenance and upkeep required on a variable prop is unbelievable. Look through the FAA airworthiness directives for propellers, and you'll see what we mean. Even if you have money to burn, a fulltime mechanic on salary, and are a hairy-chested test pilot type anyway, you won't gain anything with your fancy prop. The added weight will limit your useful load. Even for gross-weight operation, the VariEze requires a larger airport for landing than for takeoff. Climb is excellent even with a fixed pitch prop. Thus a variable pitch prop would not increase utility.



TIGER VS. VARIEZE

Since I haven't flown anything but experimental types lately I wanted to fly another lightplane to get a comparison with the VariEze. So, last month I jumped in the Continental 0-200A-powered VariEze and flew to an airport in which I could rent a Grumman American Tiger, the "hot rod" of the fixed gear lightplanes. I flew the 180-hp Tiger about 1½ hours, including 5 landings, then flew the VariEze home; my impressions follow:

Both airplanes taxied well, the Eze being easier to taxi in a direct crosswind. Both track well in the takeoff roll, the Tiger has higher stick forces required to rotate but both were easy to settle into climb attitude. The Eze rolled about 200 feet farther before liftoff but accelerated to climb speed faster. At the test conditions of 5000 feet altitude and 90 degrees F temperature the Eze had twice the Tiger's rate of climb (1200 fpm vs. 600 fpm). In level flight at the altitudes tested, the VariEze was about 30 to 35 mph faster than the Tiger at full throttle.

The VariEze is a more comfortable airplane to fly even though cabin volume is much less. The Tiger had to be constantly flown to keep it level in the light to moderate turbulence, whereas, the Eze could be flown hands-off using an occasional rudder input or trim adjustment. I had a tired back after flying the Tiger and wanted to get out and stretch. The reclined seat with thigh supports, armrests, and lumbar support in the Eze caused no discomfort. Cockpit noise levels were about equal. The Eze's ventilation was better.

The Tiger had a mild torque-effect requiring some rudder at the climb speed and the rudder requirement increased as speed was slowed to stall. Stall was preceeded by ample natural stall warning and consisted of mild pitch bucking followed by dropping of the left wing. The Eze had no noticeable torque effect with speed and the increased stick force gradient at about 51 knots was ample warning that speed was low. At full aft stick the Eze could be flown and maneuvered without tendency to depart or drop a wing, even though the angle-of-attack was excessive and totally blocked forward visibility.

Cruise visibility of the Tiger was better than the Eze, particularly forward over the nose. Both airplanes have good pattern visibility, but the Eze's forward/downward blockage hindered a good look at obstacles during final approach.

The Tiger was easier to land than the VariEze due to several factors. If the Tiger was high on final, reduction of power could produce a high sink rate and salvage the approach. The flaps were quite effective but there was a significant pitch trim change for the first 15 degrees deflection. On the other hand, if the Eze were high on final, airspeed would increase in order to get down, even with power reduced to idle. Approach speeds used in the turbulent flight conditions were - Tiger 75-80 mph, Eze 80-85 mph. The Tiger could be flared up to the numbers and when power was brought back it would immediately settle on the runway consistantly where I wanted it and I could stop repeatedly within the first 1400 feet of the runway with moderate braking, one required only about 900 feet. Touchdown scatter was considerably more on the Eze. The airplane does not lose speed or settle significantly when power is reduced; it merely flies down the runway with speed bleeding off slowly. Bringing the nose up to the horizon for touchdown resulted in a touchdown speed of about 65 mph, which was about 5 mph faster than the Tiger. Once I was able to put the Eze on the numbers, but more often touchdown occurred 400 to 500 feet down the runway, once about 1000 feet when the approach was about 10 mph fast. The Tiger with its larger tires gave a smoother rollout and braking was more effective, particularly when flaps were raised during rollout. My general impression was that a comfortable runway length for landing the Eze was almost twice as long as that required for the Tiger, when all factors were considered. On the landing I overshot, I didn't get the Eze stopped until about 2400 feet down the runway.

In summary, the VariEze definately has the edge in range, economy, cruise comfort, and performance. The Tiger with four seats, more baggage, and IFR instrumentation certainly has more utility. Its better ability to operate from short fields also increases its utility over a VariEze. The Tiger carries twice the number of people, but the VariEze can get 2.2 times the miles-per-gallon.

With the VariEze you should plan on using a minimum of 3500-foot fields for your initial landings and after your proficiency builds up you can work yourself down to as low as 2400-foot runways. Refer to the Owners Manual for specific ground roll and obstacle clearance distances.

The excessive runway requirements of the VariEze could be reduced if a drag device were deployed to dirty up the landing configuration. We do plan to test one after we get the remaining plan's sections out. Do not ask about the progress of this item, we work much faster when we don't have to respond to questions! Yes, we are designing it to be retrofittable. No, we don't know how much it will help, or even if it will be successful.

N7EZ DAMAGED

The Volkswagen-powered prototype aircraft that served as a forerunner to the VariEze was damaged last July in a landing incident. While this aircraft is considerably different than the homebuilt VariEze (N4EZ), its structure is somewhat similar. Thus, the results of the crash durability of this airplane are of interest to VariEze builders.

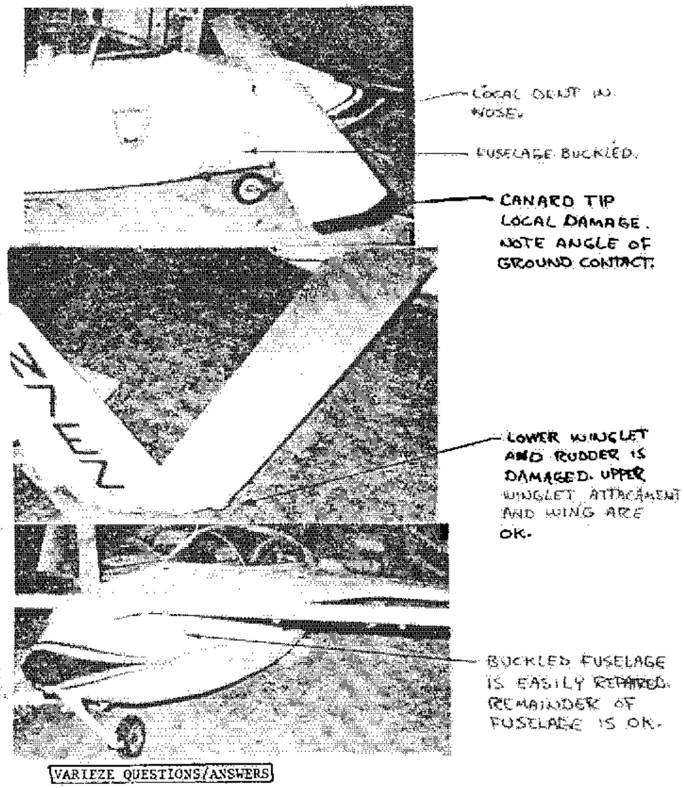
The airplane was landed in a soft dirt incline, approximately 400 feet short of the runway. The main gear failed aft at touchdown (N7EZ's gear sweeps aft, not forward as on N4EZ, and is quite weak for drag loads). The right wingtip drug into the soft dirt, yawing the airplane as it left the ground in a nose-high attitude. The yaw coupled to roll and the aircraft struck the end of the concrete runway at 60-degrees bank and about 30-degrees nose-down pitch.

First ground contact was the tip of the right canard. Rather than failing the canard, it was removed from the fuselage, taking some of the bulkhead with it. The canard then tumbled down the ramp, damaging the elevon trailing-edge skin. Damage to the canard was limited to a 3 inch by 6 inch area where it first struck the concrete. With the exception of the easily repaired area at the tip, the entire canard structure is undamaged. A metal or wood equivalent structure, striking concrete at that angle at 65 knots, would have been destroyed.

Next ground contact was the nose of the airplane and the wingtip simultaneously, with the aircraft still at 60-degrees bank and 30-degrees nose-down. Wingtip damage was limited to the lower winglet surface. The nose took the major impact energy and resulted in a buckling of the structure around the fuselage under the canard mount, as the entire nose section moved back about one inch (see photos). The airplane then slid down the runway about 200 feet on the nose gear and wingtips. The bottom of the rudders, prop, and both lower wingtips were damaged in the slide. The nose gear pushrod (NG10) buckled between NG1 and NG13. The landing gear strut was not damaged.

All structure not noted above was not damaged. The upper winglets, winglet attachments, wings, wing fittings, spar, fuel tanks, fuselage, cockpit, canopy, etc., were not shifted in any way. The engine did not shift, and there were no fuel leaks. The pilot received no injuries even though he had forgotten to put on his shoulder harness.

It is quite disappointing, of course, to have the aircraft damaged, but was encouraging to obtain impact survivability data that is very favorable to the structure. This was an area that was somewhat unknown. Many of the all-glass sailplanes have a history of shattering the fuselage structure in a crash. Apparently the sandwich of glass/foam/glass used throughout the VariEze provides energy absorbtion, limits the damage to local buckling, and provides good pilot protection.



VARIEZE QUESTIONS/ANSWERS

We *still* get an occasional letter asking a question, but without a self-addressed, stamped envelope enclosed. We will assume that if a SASE is not enclosed, the writer does not want his question answered until the next newsletter, so, if you want prompt reply, send the SASE. Questions about availability cost and delivery of items handled by a distributor should be sent directly to them, not RAF. The distributor can process your questions faster if you send them a SASE too.

Question - Is any of the material and hardware on page 2 - 1 duplicated on page 2 - 2?

Answer - No. If you homebuild the prefab parts you will need to get the materials and hardware separately.

Question - By experimenting, I have found that RAEF behaves similar to RAES if it is mixed six to one ratio. Is this o.k.?

Answer - No! Never change specified ratios on epoxy. Never do anything contrary to the education section of the plans without getting complete justification.

Question - I plan to put a starter, vacuum pump, alternator, complete electrical system, complete IFR instrumentation and lighting in my Eze. Where do I put the ADF antenna?

Answer - First of all, we do not recommend that you plan for IFR utility on any homebuilt. Get out your FAR part 91 and see that an experimental airplane can operate "VFR, day only, unless otherwise specifically authorized by the Administrator" (part 91.42). Some local FAA authorities will approve IFR or night capability, but many require specific approval for each flight. The important thing is that FAA can prohibit homebuilt IFR merely by discontinuing the 'specific authorizations', not by having to change a regulation. I feel this will happen the first time a homebuilt has an IFR accident, particularly in a TCA. So, it is foolish to tie up alot of money in IFR equipment that you may not be able to use. If you must have IFR utility, we recommend you use a type-certified aircraft. Remember, a homebuilt aircraft must be built and flown for "education and recreation only." The current United States rules are the most lenient in the world and were written to accomodate local recreational flying only. I think the best way to keep our rules is to not try to overextend their intent and to do our recreational flying as safely as possible. Night-flying a high wing-loading single-engine airplane is not considered safe practice. Secondly, you are loading up the wrong airplane. The VariEze has only 67 square feet of wing area and is thus effected much more by weight growth than a Cub or Flybaby, which has twice the wing area. You will be much happier with your VariEze's flying qualities, performance and safety if you operate it as light as possible. The maximum engine weight is 215 lb., which does not allow use of the starter and generator on all of the Continental engines. Basic and accessory weights for all the Continental engines are shown in section IIA. Due to fuel system requirements you cannot use the engine-driven vacuum pump. If you must use a vacuum instrument, you must use a venturi to drive it. Remember, due to the aircraft's small size it is not adaptable to heavy installations. The 215 lb. value is an absolute maximum. The 170 lb. A - 75 is preferred, and was the design point. The A - 75 is probably the best engine for the VariEze. Now, back to your original question, the best place to put the ADF antenna is on a Type-Certified airplane.

Question - I am learning aerobatics. What maneuvers and entry speeds do I use for the VariEze?

Answer - You are using the wrong airplane. The VariEze was not designed for aerobatics and thus an aerobatic test program has not been done. To clear you for aerobatics, I would have to conduct a complete series of tests including inverted maneuvers, tailslides, 6-turn spins, expansion of structural maneuvers, etc. I do not plan these tests because I have no requirement or intention to clear aerobatics. Further-more, the introduction of an all-composite structure to homebuilding is a big enough step in itself, considering the wide variety in workmanship. It would be unwise to introduce a new-type structure in an aerobatic airplane, particularly one in which inexperienced aerobatic pilots would operate. This is not to infer that an all-composite airplane has no future in aerobatics. I just think it is wise to gain several years experience in a non-aerobatic airplane first. Do not exceed the placards/limitations in the owners manual. If you are considering aerobatics, do them only in an aircraft approved for them.

Question - I am a Ham radio operator. Can you set up a frequency and time for Hams to discuss VariEze?

Answer - Ivan Whitehouse, Goldendale Wash, reports they are using 3900 khz at 8:30 P.M. Tuesday nights.

Question - Is it possible to hit the wingtip on the ground during landing?

Answer - Yes. It happended to N4EZ once. I was making an approach to Dalhart Texas on the way to Oshkosh on a gusty afternoon. On short final the airplane had a very large turbulence upset. I recovered to level flight and continued the approach. In the flare for landing I encountered another large gust which drove a wing tip into the ground and gave me a very hard touch down. The landing was quite hard and due to the shock and noise I thought I may have broken the prop or gear. I taxied in and found that both lower winglets had struck the ground. Everything else was o.k. One of the lower winglets had been shortened about 1/2 inch and was split on one side. The other had been ground off about 1/4 inch. Repair was easily done with some 5-minute and a spray can of paint.

Question - I have enclosed a sketch showing my solution to hooking up a dual control setup on my VariEze so I can make it easier to check-out my friends. Will it work o.k.?

Answer - No. Dual controls for the VariEze are not as simple as just rigging a mechanism to the back seat. First of all, we are concerned that with dual controls many will be attempting to use the airplane as a trainer, checking out people who do not meet the qualifications shown in the Owners Manual. This goes for any homebuilt - get your basic proficiency in Type-Certified training aircraft. Do not risk EAA's safety record by learning flying skills in a homebuilt. A very large percentage of homebuilt accidents can be traced to a lack of basic pilot proficiency. Second, the VariEze's roll rate due to rudder is higher than that due to aileron, thus it is important that the back seat instructor has good rudder control. The back seating is arranged such that the passenger's foot sits flat on the inclined floor, making it difficult to provide good rudder pedal control for a tall instructor. Back seat controls would require a major structural addition to the fuselage and would eliminate one suitcase. When we do provide back seat controls we plan to also incorporate rear wing ailerons to improve the roll flying qualities, since if we're going to complicate the control system that much, we might as well go all the way! The rear wing aileron addition is a very major change that affects wing stiffness and would require extensive flutter qualification. Do not build a VariEze if you require dual controls (with the assumption that they could be worked out). They may not work. Do not ask how the dual development is working out. If it is successful details will be provided immediately.

Question - I plan on notching into the wing to make the roll trim tab flush. Is this o.k.?

Answer - No. Do not modify the wing. Changing its stiffness would require extensive flutter qualification.

Question - On chapter 6 step 9, which fasteners do you prefer?

Answer - The AN 525's are highly desired since the precision countersink operation is not required. Performance loss with the external screw heads is less than 1/2 mph speed.

Question - I know my VariEze elevons should go trailing-edge-up 27 degrees, but I got something crooked & mine hit the canard at only 25 degrees. Do I have to start over?

Answer - No. 27 is preferred, but you can accept as low as 24 degrees If less than 24 degrees is obtained you will have to adjust CS3. Do not adjust CS2. The position of CS2 relative to the elevon is important to provide the correct stick forces.

Question - Can I get a list of those in my city who are building a VariEze?

Answer - We don't have a geographic list, but you can find other builders by speaking up at your next local EAA chapter meeting.

Question - I understand from an article by Glenn Sievert in the October "Sport Aviation" that Dynel fabric has better flexural strength, but less tensile strength than glass. I have some Dynel left over from another project. Can I substitute it for glass?

Answer - No. Mr. Sievert's "comparison" of Dynel and glass tensile strength which shows glass 2.6 times as strong as Dynel is very misleading. Hehas selected equal cloth weights, but in fact, due to Dynel's thickness and "burlap" consistency, it results in a lamina that is 3.5 times as thick as the 100-gram cloth per ply, and proportionately heavier. In a correct compairson (in lb/in^2 tensile strength) the epoxy/glass lamina is over ten times as strong as an epoxy/Dynel lamina. The foam core in his tension sample cannot be assumed to carry its share of the ultimate tensile strength due to the greatly different modulus of elasticity; ie., the foam will not be highly stressed until after lamina failure. His "flexural ultimate" test is not really a test of the lamina flexural strength, because due to his test setup, the compressive allowable stress of the foam core was reached long before apporaching tensile/compressive allowables in the lamina. The fact that his .014 thick Dynel lamina spread the foam compression load over a larger area than the .004 thick glass lamina, resulted in a higher foam core buckling load for the Dynel. The Federal Test Method used could be done on a multi-ply lamina of Dynel or glass without the core and would result in the correct values of flexural ultimate for the material in which glass is again over ten times the strength of Dynel. If Dynel were used for the VariEze spar caps the caps would have to be over one-inch thick where the glass caps are only 0.1 inches thick.

AMATEUR DESIGNERS

Composite structure, as we have said many times, is not adaptable to amateur design practice. The simplified (sometimes eyeball) design methods that have evolved through the years of experience with steel tube, simple wood, and aluminum structure do not exist for composite structures. The structural composite is the baby of all aircraft structures and it will need the years of service experience that the older materials have had to mature before the common practice and "thumb rules" for amateur design evolve. Remember, steel, aluminum, and wood have had 40 to 70 years to mature as aircraft structural materials. Composites have scarcely even flown as primary structures. The best qualified engineers in the field are still arguing among themselves about the design criteria for composites, and if the true experts are still not set on the best approaches, the amateur shouldn't even try. If you aren't a well-qualified structural designer with a good composites background, don't even consider the use of composites in an original design of your own!

Unfortunately, a few foolhardy individuals have already attempted to use composite structures in aircraft without adequate knowledge and the results have been catastrophic. In mid-July the prototype of a foam/dynel/epoxy airplane had a catastrophic in-flight structural failure. The impact killed the pilot/designer/builder but fortunately nobody else. The FAA's post crash investigation revealed errors in both design and workmanship that would give a competent composites engineer prematurely gray hair. Specifically, the full depth foam leading edge (about 30% of chord) was not structurally attached to the spar and incapable of transmitting shear loads to the spar. The only thing holding the first 30% of chord to the wing spar was the dynel/epoxy skin, and the skins had been virtually sanded through in persuit of a nice exterior finish.

SHOPPING

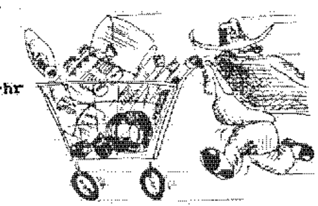
The following individuals or companies have contacted us indicating that they have Continental engines for sale. We cannot endorse them since we haven't seen the engines, but we are referring you engine hunters to them as a possible source.

J. W. Duff Aircraft Co. - all types: A65-0-200
8131 3 40th
Denver, Co 80207
(303) 399-6010

Champion Aero Serv. - A65's
801 Airport Rd.
Springdale, Ar 72764
(501) 756-1760

Nathan Puffer - 0-200A, 875-hr SMOH
2182 N Payne
St Paul, Mn 55117
(612) 776-1145

Wes Winter - new 0-200A
6910 N Stardust Cir.
Tucson, Az 85718
(602) 297-4125



Ray Phillips - four runout A-75's/$450 each
291 San Bernabe Dr.
Monterey, Ca 93940

Radio Systems Technology now has a build-it-yourself VHF 2-channel (Heath kit style) radio for about $200. Looks like a real good way to keep operating out of your local airport after FAA moves their tower in. Contact them at Box 23233, San Diego, Ca. 92123.

George Evans and Bill Campbell now have VariViggen fuel tanks. The photo shows some of the VariViggen metal parts from Bill Campbell (NEXT PAGE).

Spraylat is no longer available in small quantites at the address in chapter 22. Contact Cowley for Spraylat.

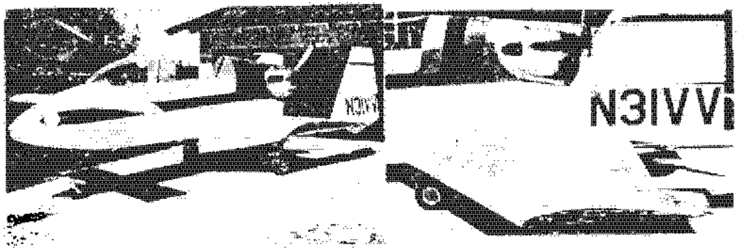
Rich Steck (Eze S/N 662) has made up a handy logbook to serve as a complete diary of the VariEze construction to keep track of your materials and building times. It also helps organize FAA papers, changes and includes a guest register. He will sell you a copy for $3.50. Contact him at 536 16th Ave, N.E., St. Petersburg, Fl 33704.

Jerry Trump (VV S/N 313) has new Ford window-lift motors for $47 each, in shipset quantities. Also, LS-806 pulleys for $2.75. Contact him at 322 N Mountain, Monrovia, Ca 91016.

Jacket patches are not shown in the RAF product sheet. They are three inches high, three-color and consist of a shield outline with a planview of the airplane. Specify VariEze or VariViggen. They are $1.95 each.

I understand that Moorabbin Aircraft Spares, Box 68, Cheltenham, Victoria, Australia, has in stock many of the materials and hardware items for you Australian VariViggen builders.

Jesse Wright (see distributor's list) has made up a comprehensive list of parts and description with the prefab VariViggen wood parts he sells. Those VariViggen builders who are just now starting construction should send him 50¢ for his list. Prefab parts can save alot of work.

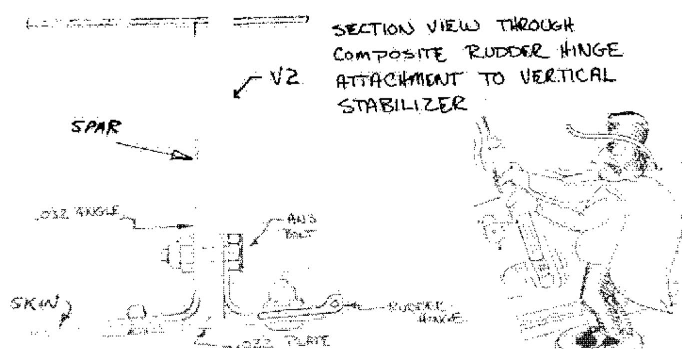


VARIVIGGEN ACTIVITY

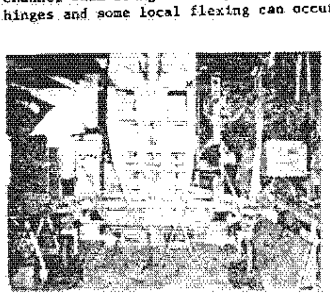
N27VV made its annual flight to Oshkosh again this summer. The VariViggen prototype has flown to the EAA convention the last 5 years. It has undergone no modifications since the last newsletter. Flying time since newsletter No. 9 was only about 40 hours. No recurrence of last years landing gear problems have been experienced. The O-320 Lycoming now has about 2000 hours since major, the entire run without problems or unusual maintenance. We did encounter a fuel problem on the way back from Oshkosh. The engine surging during descent that had occasionally been noticed (see newsletter No. 9) started to get worse. When the fuel starvation started to occur in level flight we knew something was wrong! Closer inspection revealed that the fuel screen in the gascolater was clogged with a green substance that appears to be the sloshing compound used in the fuel tank. There had been no breakdown of the sloshing compound (an approved zinc chromate type) over the previous 4 years. The airplane has just recently started to use 100LL fuel occasionally, so possibly a compatibility problem exists. We don't really know, but we are sure going to check our fuel filters more often. After cleaning the screen there has been no recurrence of the surging, even in steep descents. About 15 of those building the VariViggen got rides this year at Oshkosh.

VARIVIGGEN PLANS CHANGES

S.P. WING PLANS	Note caution on epoxy exotherm discussed in the VariEze section of this newsleter. Page 27- 1.75 dimension should be 3.5.
Plans pg 5	AN4-21A (18) should be AN4-22A (46)
Plans pg 26	AN4-21A should be AN4-22A.
Plans pg 42	Some builders have found that RB2 interferes with WR30. Before drilling in RB3 check this and move inboard if reqûred.
Plans pg 53	The wireing diagram results in the three green lights going off when there is weight on the gear (squat switch) (Harold Reiss I owe you a Coke!) While this is not standard practice it is actually a good system since the squat switch is checked on each flight and the "three green" indication on the ground can be checked by flipping the "squat-override" switch.



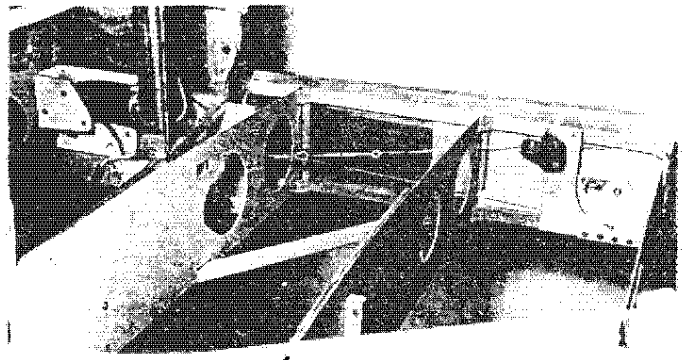
Harold Reiss (s/n 267)
Harold has finished everything but the outboard wings and canopy. He is using composite wings and rudders. He suggests stiffening the V2 channel when using the composite rudders, since they do not use full-span hinges and some local flexing can occur. Refer to the accompanying sketch.



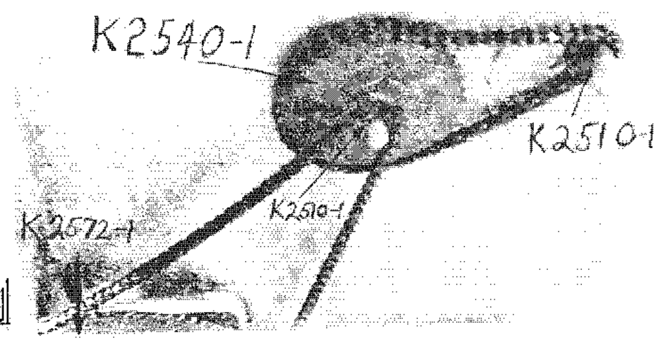
FRANK TOMCO'S PROJECT IS A TIGHT FIT. IN A PINCH THE CAR WILL FIT IN TOO!

VARIVIGGEN PROJECT REPORTS

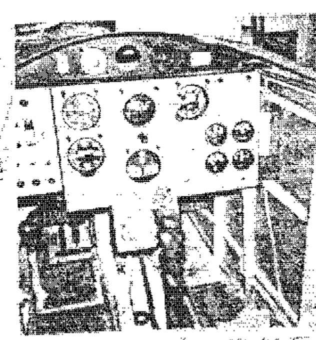
Jim Cevis (s/n 31)
The two photos show (1) the front half of the two peice canopy. Sure gives his Viggen a better look than N27VV. (2) Jims standard wing shape using composite construction. Note the shorter aileron span. The aileron will be balanced similar to those on the S.P. wing. If this configuration works, Jim plans to provide construction details in the second part of the construction manual, which may be available sometime this winter. By the way, Part 1 of the VariViggen Construction Manual was inadvertently omitted from the product sheet included in this newsletter. It is available from RAF at $18.50 ($20.50 overseas). Maybe we can get Jim to also show construction details on that pretty 2-piece canopy.



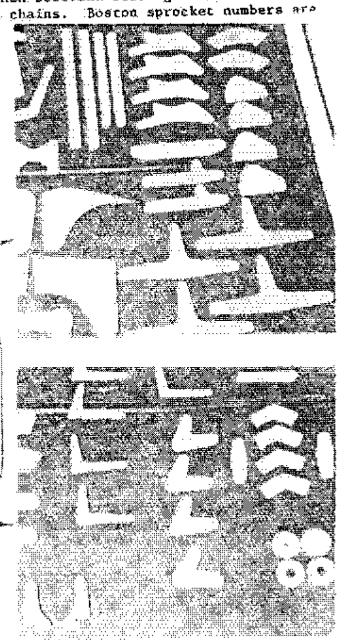
Charles Allen (s/n 27)
Charles moved the main gear retraction motor assembly forward 5 inches to provide better cable access (as suggested in newsletter No. 7). He built a new bulkhead in front of F152 and tied it into the WR12 ribs with gussets. The photo shows the installation of the motor gears and extra pulleys. He plans to provide turnbuckle access through an inspection door on the bottom skin. He used Boston chain on the nose gear and used the NG1 spool as an idler to adjust cable slack.



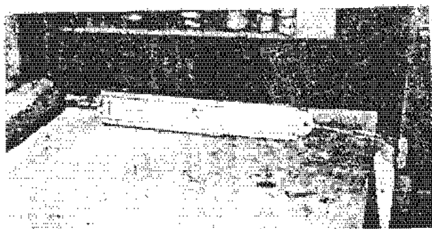
Jack Rosen (s/n 402)
Jack has eliminated the gears on the nose gear system by a two-stage #25 Boston chain drive. The upper sprocket mounts on the AN5 bolt through the belcrank bearing shown on the plans. The upper and center axles mount to a reinforcing plate on F31 that consists of 1/4 inch ply and 1/8 inch aluminum. The 5/16 inch belcrank bearing on the center pivot is adjustable to adjust both chains. Boston sprocket numbers are shown on the photo.



HAROLD REISS' INSTRUMENT PANEL LAYOUT



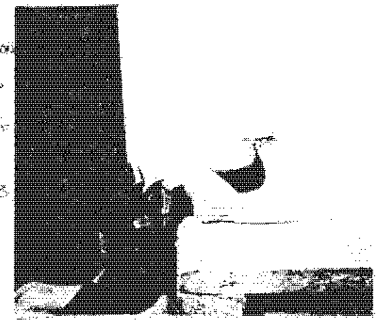
METAL PARTS FROM BILL CAMPBELL (SEE SHOPPING)

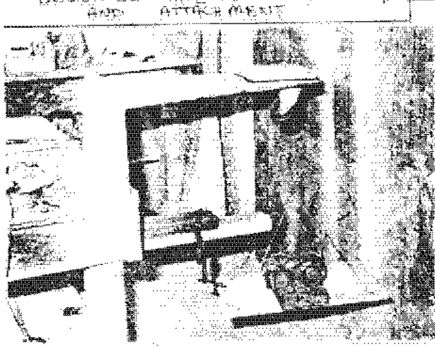


THE STATIC LOAD → PRODUCED NO FAILURE, SO WE TRIED A DYNAMIC TEST LOAD

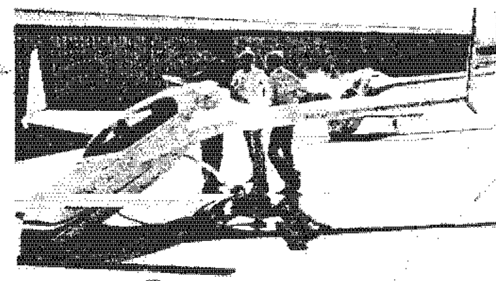
← VECS 3 SHOWS NO INDICATION OF LOOSENING AFTER SOME GOOD BASHES, SO WE TRIED WRENCHING IT OUT WITH PLIERS, → AND FAILED EG 3 FIRST.

DESIGN ULTIMATE LOAD ON VECS 3 AND ATTACHMENT

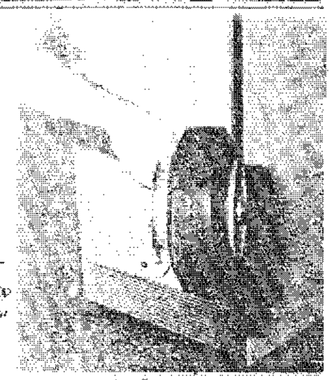




← STATIC LOAD TESTING THE WINGLET TO WING JOINT →

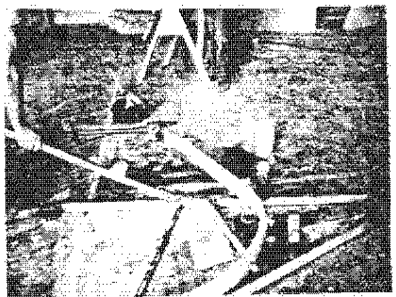


WHAT'A YA MEAN, YOUR EZE IS SHINIER THAN MINE?



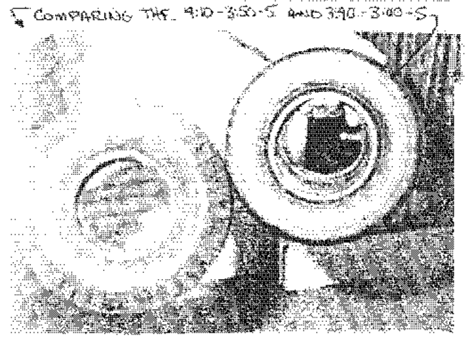
← 3.40-3.00-5 TIRE MOUNTED ON THE CLEVELAND 5" WHEEL.

← PHIL TESTA RECEIVING THE FIRST SET OF EZE PLANS ON JUNE 26.



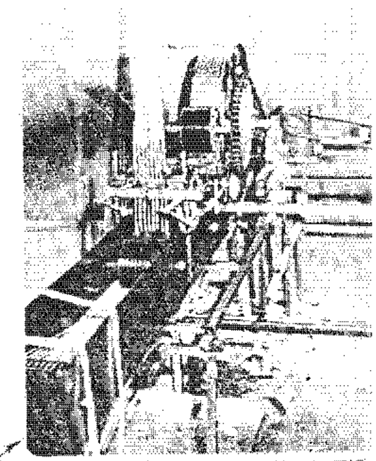
← STATIC LOADING A PRODUCTION GEAR LEG.

← COMPARING THE 4.10-3.50-5 AND 3.40-3.00-5

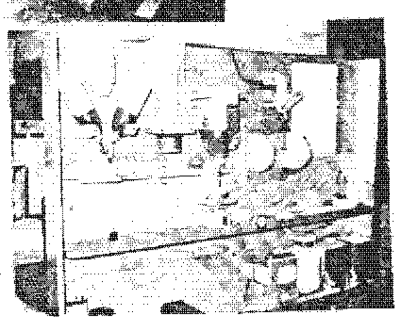


← PHIL TESTA'S EZE PROJECT IN EARLY SEPTEMBER!

OSHKOSH WORKSHOP! SOMETIMES IT WAS HARD TO GET YOUR QUESTIONS ANSWERED.



← THIS BIZZARRE CONTRAPTION IS THE ROVING IMPREGNATING MACHINE DESIGNED & BUILT BY FRED JIRAN FOR VARI EZE LANDING GEAR PRODUCTION.



← NO MARTIAN. ONE OF FRED'S TROOPS CLEANING UP A MAIN GEAR LEG BEFORE DELIVERY.

The following information has been distributed to all FAA offices responsible for homebuilt inspections and to those foreign inspecting authorities requesting it.

AMATEUR-BUILT VARIEZE INSPECTION CRITERIA

1.0 Scope
This document has been prepared to assist inspection personnel by providing recommended acceptance criteria and acceptable repair practices for the VariEze amateur-built composite sandwich structure.

2.0 Background Information

2.1 Design Criteria
The materials, methods, and practices employed by the amateur builder in the construction of the VariEze type are new to light aircraft construction and may be unfamiliar to the inspection personnel involved with the licensing of amateur-built aircraft. Structural design criteria for the VariEze exceed F.A.R. part 23 requirements. In-house component testing of the primary flight structure has been conducted to 200% of design limits. Detail documentation of test data is on file at Rutan Aircraft Factory. The aircraft is considered to be a utility category aircraft. VariEze builders are being supplied with a complete owner's manual which specifies all placards, operating limitations, normal & emergency operations, flying qualities, maintenance specifications, inspection procedures, & initial flight test procedures.

2.2 Structural Approach
The basic structure throughout the design is a composite sandwich of load bearing fiberglass skins separated by a light-weight foam core. While the materials and processes are tailored to the amateur builder, the structural layout is very similar to the honeycomb composite structures utilized in military and transport type aircraft and fiberglass sailplanes. Loads are carried by epoxy/"E"-type fiberglass lamina. Foams of various types and densities are employed as a form (upon which the load bearing material is shaped) and as local buckling support. In no instance are foams used to transmit primary loads, as is the case in some other amateur-built designs.

2.3 Inspection Techniques
The transparent nature of the fiberglass/epoxy material allows for visual inspection of primary structure from the outside prior to finishing. Defects in the structure, as described in paragraph 3.0, are readily visible even in the deepest laminate.

2.4 Inspection Sequencing
The external visual inspection capability provided by the materials allow inspection of all primary structures at any point before finishing. All primary structures are at the surface, eliminating the requirement for "pre-cover" or "closure" inspections. Opaque filler materials are used throughout the airplane in finishing, and inspection must take place before any areas are obscured. Some areas may have opaque materials applied to one surface where the structure is inspectable from the opposite side (wing trailing edge for example).

3.0 Defects

3.1 Voids
Interlaminar voids in a new layup may be due to small air bubbles trapped between plies during the layup. These void areas look white and are distinctly visible even deep in a cured layup. Interlaminary voids up to 1 inch in diameter do not require repair, as long as they do not consist of more than 5% of the surface area.

Interlaminar voids (air bubbles) up to 2 inches in diameter are acceptable when repaired as follows: A small hole is drilled into the void and epoxy is injected into the void area. Small voids such as this may occupy up to 5% of the laminate surface area.

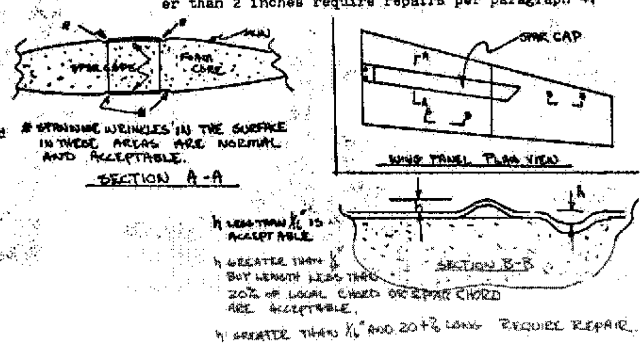
Voids greater than 2 inches in diameter should be repaired as shown in paragraph 4.

3.2 Lean Areas
Areas where the epoxy/glass matrix is incomplete because of inadequate wetting of the cloth with epoxy (lean areas) are speckled whitish in appearance. The fully wetted laminate will have a consistant transparent greenish appearance. Epoxy lean areas are acceptable, as long as the white speckled area is less than 10% of the surface area. White-to-green ratios greater than 10% require rejection or repair as shown in paragraph 4.

3.3 Rich Areas
Resin richness primarily adds weight to the laminate. While some degradation of physical properties does occur, a overly wet (rich) layup is not grounds for rejection.

3.4 Inclusions
Bristle paint brushes are used throughout the layup process. As a brush begins to deteriorate it will shed some bristles into the laminate. The bristle inclusions, up to 20 bristles per square foot are not cause for rejection. Occasional inclusion of small woodchips or other small foreign objects is not grounds for rejection.

3.5 Fiber disruption
In all instances, it is good practice to have the glass fibers lying flat and without wrinkles. Major wrinkles or bumps along more than 2 inches of chord are cause for rejection in the wings, canard, and winglets, particularly on the upper surfaces (compression side). Disruptions greater than 2 inches requires repairs per paragraph 4.



3.6 Finishing Damage
Damage to the external structure by sanding in preparation for surface fill and paint can occur. Occasional sanding through the weave of the first skin ply is not grounds for rejection. Sanding through areas greater than 2 inches in diameter completely through the first ply or any damage to interior plies must be repaired in accordance with paragraph 4. A damp rag passed over the sanded surface will make the plies show up to determine how many plies have been sanded away.

3.7 Service Damage
Damage to the glass structure will be evidenced by cracked paint, or "brooming" of glass fibers. Both of these indicators are clearly visible. If either type of indication is present the paint and filler should be sanded away, bare laminate inspected, and repairs made per paragraph 4 as required. Where surface damage has occured it is also likely that local foam crushing has been inflicted.

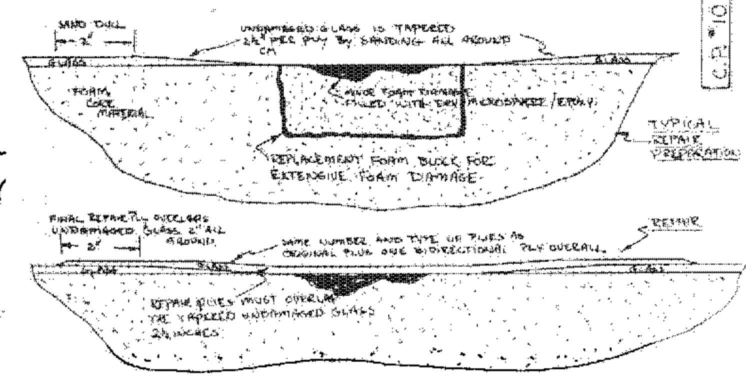
3.8 Delaminations
Delamination of glass/epoxy lap joints is evidenced by physical separation of plies. These defects are easily visible and easily repaired. The leading and trailing edges of flying surfaces (wing, canard, winglets) should be free of delaminations.

3.9 Multiple Defects
Where multiple types of small defects occur in a laminate (voids, fiber dislocations, and lean areas for example). They should not exceed a total of 10 % of the surface area of the laminate, or 20% of the wing chord at any one spanwise position.

4.0 Repairs
There are seldom single defects so massive that a major component must be scrapped. The repair procedures described here may be applied throughout the VariEze and VariViggen SP composite sandwich structures.

4.1 Small Void Repairs
Voids up to 2 inches in diameter may be repaired by drilling a small hole into the void and injecting the void full of epoxy. A vent hole opposite the injection point is required to allow air to escape.

4.2 Large Defects
Excessively large voids, lean areas, finishing damage, fiber disruptions, major fiber wrinkles, or service damage may be repaired using this procedure. Remove the rejected or damaged area by sanding or grinding and taper the glass laminate on a slope of approximately 2½ [redacted] CM per ply in all directions. The plies are visible as the sanding is done. The tapered glass edges and surrounding two inches of glass surface must be sanded completely dull. Damaged underlying foam should be removed and the void filled with a dry microsphere/epoxy mixture or a replacement foam piece. The damaged area is then laminated over using the same type and orientation of glass plies removed, each ply lapping onto the undamaged glass at least one inch. The whole repair area is covered with an additional bi-directional glass ply.



4.3 Delaminations
A delaminated joint should be spread, the mating surfaces sanded dull, gap filled with flox (epoxy/flocked cotton mixture), then clamped shut while it cures.

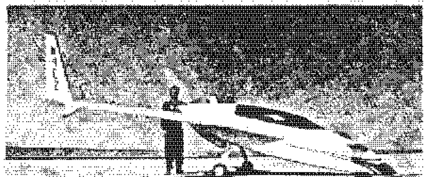
5.0 Materials
Since a wide range of similar appearing materials exists which exhibit substantial differences in physical (structural) properties, Rutan Aircraft Factory has established a distribution system to provide the amateur builder with proven acceptable materials. RAF strongly discourages the substitution of materials. Homebuilder substitutions for the basic structural materials constitutes major structural modification to the VariEze design, and could adversely effect flight safety.

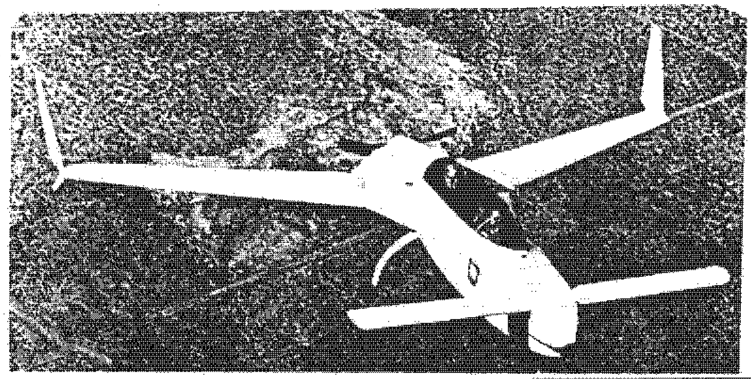
6.0 Applicability
These acceptance criteria are different from and, in some cases, much looser than for similar structures found in sailplanes and other contemporary composite structures. These criteria apply only to the VariEze and VariViggen structures. Design safety factors in excess of three enable somewhat relaxed acceptability criteria compared to other similar structures.

THANK YOU FOR YOUR INTEREST IN THE

VARIEZE

TWO-PLACE SPORTPLANE





THE STORY

For the last 12 months, we have refrained from promotional activities and marketing on the VariEze to concentrate totally on its development and setting up materials and components distribution. In this short time, we have 1. flown a full 350 flight-hour test program on two prototypes, one Continental and one VW-powered. 2. completed full structural qualification testing, 3. prepared a manual for the amateur builder to educate him in the structural materials and to guide him through construction, 4. set up a materials distribution system through established, competent distributors.

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 RESULTS

The VariEze has superb flying qualities for its primary mission - comfortable travel. It has excellent hands-off stability even in turbulence. It is unusally safe at low speeds, can be flown with full aft stick (47 kt) without being susceptible to departure or spin, regardless of attitude or power. Performance is also superb - cruise up to 200 mph and climb up to 1700 fpm at gross weight with the larger engines.

THE MISSION: PRACTICAL UTILITY

Although quite compact outside, the VariEze provides unusual comfort for up to 6-ft, 7-in, 210-lb pilots and 6-ft, 5-in, 220-lb passengers, plus two medium-size suitcases and four small baggage areas. The 24-gallon fuel load allows up to 1000-mile range at economy cruise. High altitude climb is excellent, for flying over turbulence, mountain ranges, and for satisfactory high-density altitude take offs.

THE DESIGN

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 STRUCTURE

New composite sandwich structure offers the following advantages over conventional wood or metal: less construction time requiring less skills, improved corrosion resistance, longer life, improved contour stability, better surface durability, dramatic reduction in hardware and number of parts. easier to inspect and repair.

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. Construction seminars are provided at RAF and elsewhere.

MATERIALS & COMPONENTS

Established, competent distributors are delivering all required raw materials and many manufactured components including canopy, landing gear, wing quick-disconnect fittings, cowling, a variety of small machined parts, rudder pedals, engine mounts, suitcases and upholstery. The VariEze airframe (no engine or prop) materials costs range from $2000 to $3500 depending on the number of prefab components purchased.

VariEze documentation is available in five sections.

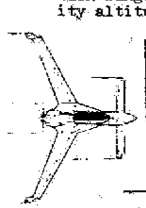
SECTION I - MANUFACTURING MANUAL - This is the complete education manual for composite materials and methods, also, the complete plans and construction manual for the entire VariEze except engine installation. The manual consists of a 153-page, bound, 11"x17" book plus nine larger full-size drawings. 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.

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-200

SECTION III - ELECTRICAL - This is an optional (not required) set of drawings and installation instructions for electrical system, avionics, landing and position lights, antennaes, starter.

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.

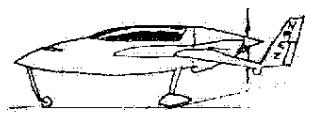


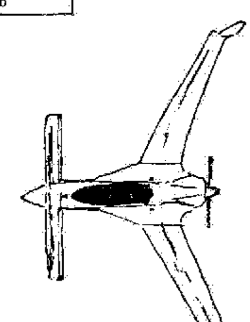
Specs & performance with 100-hp Continental, fixed-pitch prop, @ gross weight			
Take Off 800 ft	Range @ Max Cruise 720 mi	Canard Span/Area 12.5'/13ft²
Climb 1700 fpm	Range @ Econ Cruise 980 mi	Wing Span/Area 22.2'/53.6ft²
Max Cruise 200 mph	Min Speed (full aft stick) 49 kt	Empty Weight 520 lb
Econ Cruise 165 mph	Landing 900 ft	Gross Weight 1050 lb

Specs & performance with 75-hp Continental			
	Take Off 950 ft	Max Cruise 178 mph	Empty Weight 490 lb
	Climb 950 fpm	Econ Cruise 145 mph	Gross Weight 950 lb

Check items desired:	Price, including First class mail U S and Canada	Air mail Overseas*
VariEze Info Kit, includes current issue of "Canard Pusher" newsletter	$5.00	$6.00
"Canard Pusher" newsletter, published quarterly. One-year subscription	$4.75	$6.50
Section I	$94.00	$108.00
Section IIA	$19.00	$21.00
Section III	$8.00	$9.50
Section IV	$8.00	$9.50
Section V	$7.00	$8.00
VariEze Jacket Patch	$1.95	$1.95
Calif. residence add 6% tax on all items except newsletter		

* U.S. funds only





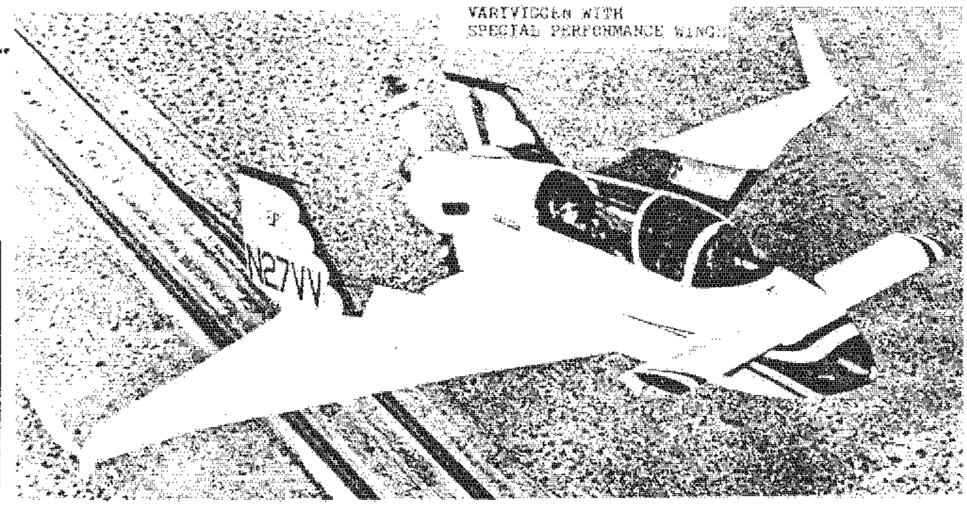
Rutan Aircraft Factory

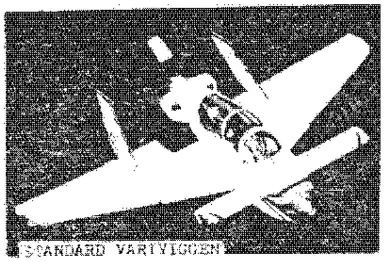
BUILDING 13, MOJAVE AIRPORT
P.O. BOX 656, MOJAVE, CA 93501
TELEPHONE (805) 824-2645

THANK YOU FOR YOUR INTEREST IN THE

VARIVIGGEN

TWO + TWO SPORTPLANE





Performance with 150-hp, fixed-pitch prop, gross weight. Standard VariViggen			Specifications Standard VariViggen		
	Take off	850 ft		Canard Span/Area	8 ft/18.3 ft^2
	Climb	800 fpm		Wing Span/Area	19 ft/119 ft^2
	Cruise	150 mph		Empty Weight	950 lb
	Full Aft stick	49 mph		Gross Weight	1700 lb
	Landing	500 ft			

Performance with 150-hp. Special Performance Wings		Specifications Special Performance Wing	
Climb	1000 fpm	Wing Span/Area	23.7 ft/125 ft^2
Cruise	158 mph	Gross Weight	1700 lb

PROVEN DESIGN
Complete flight test program completed: 600 hours on prototype with very little maintenance. Won the Stan Dzik trophy for design contribution, Oshkosh '72.

STALL/SPIN SAFETY
The VariViggen's safe flying qualities have been the subject of technical presentations for EAA, SAE, AOPA, & AIAA. It will not stall or "mush in" like the common delta. At full aft stick (43 kts) it will still climb 500 fpm, roll over 50 degrees per second without rudder co-ordination, and make buffet-free turns. The prototype received the Omni Aviation safety trophy at Oshkosh '73, and the outstanding new design award at Oshkosh '74.

EXCELLENT UTILITY
Comfortable tandem cockpits, three-suitcase baggage area, and an adequate cruise speed provide unusual utility for a homebuilt airplane. Its unusual design turns routine travel into "fun trips." Gas service and other airport services have been better, too! Take it home; it's road-towable with outer panels removed.

UNCOMPLICATED CONSTRUCTION
The basic structure requires few special tools and can be built in a simple jig. The few parts that have double-curvature are available in fiberglass, ready to install. All machined parts are also available, as well as other prefab parts.

EASY TO FLY
Despite its unique appearance, the VariViggen has no unusual or pilot-demanding flight characteristics. It is easier to handle than conventional aircraft, particularly in gusty crosswind conditions.

VARIVIGGEN CONSTRUCTION MANUAL Part 1 of a photo-illustrated construction manual, written by Jim Cavis, S/N 31. Includes fuselage, canard, inboard wing, vertical stabs, control system, and landing gear, along with approximately 100 photos. Part 1 also includes helpful sketches on jigs and numerous building tips. The written information is similar to plans chapter 5, except expanded to about 30 pages.
Price: $18.50 first class mail, $20.50 airmail overseas.

Rutan
Aircraft
Factory

BUILDING 13, MOJAVE AIRPORT
P. O. BOX 556, MOJAVE, CA 93501
TELEPHONE (805) 824-2645

VARIVIGGEN TECHNICAL REPORT - Complete tech report describing the VariViggen two-place sportplane. Includes specifications, pilot report, dimensions, 3-view, stability and performance flight test data, construction cost, description of car-top wind tunnel, 8"x10" glossy photo and current issue of newsletter.
Price: $10.00 first class mail, $11.50 air mail overseas.

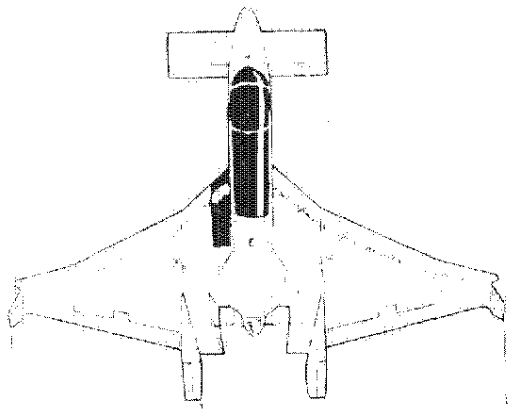
VARIVIGGEN OWNERS MANUAL - Complete operational handbook including normal and emergency procedures, loading, operational record keeping. This manual is a must for those close to first flight.
Price: $6.00 first class mail, $7.50 air mail overseas.

"CANARD PUSHER" SUBSCRIPTION - A newsletter designed with the builder in mind. Emphasis on distributing to all builders as many ideas, improvements, building tips, photographs, & flight reports as possible. Details mandatory, desirable, & optional changes to plans & to owners manual. A newsletter subscription and all back issues are mandatory for those with VariViggens under construction. Identifies new material sources as they become known. Published quarterly.
Price: $4.75 per year first class mail, $6.50 air mail overseas.
Back issues: $1.00 each

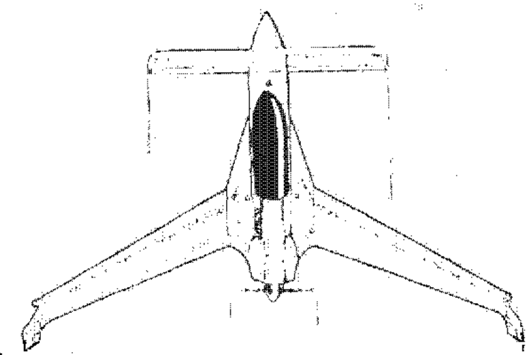
VARIVIGGEN PLANS - NASAD approved in "AA" catagory. Sixty-one sheets, completely detailed. Also included are builder's handbook information, step-by-step construction guide, complete bill of materials, flight operating limitations, parts lists. Section breakdown: 1. Introduction, 2. Operating Limitations, 3. Bill of Materials, 4. External Geometry (Lofting), 5. Building Tips, 6. Construction Order & Methods, 7. Canard & Elevator, 8. Fuselage, 9. Inboard Wing, 10. Verticals & Rudders, 11. Outboard Wings, 12. Cockpit & Seats, 13. Canopies, 14. Flight Control System, 15. Fuel System, 16. Angle-of-Attack System, 17. Engine Mount, 18. Cooling & Cowling, 19. Landing Gear, 20. Gear Doors, 21. Electrical System, 22. Parts List. Also included are the tech report & photo described.
Price: $53.00 first class mail, $59.00 air mail overseas.

VARIVIGGEN SPECIAL PERFORMANCE (SP) WING/RUDDER PLANS - Construction drawings and assembly manual for glass composite outer wing panels and rudders. These are optional wings, replacing the aluminum surfaces shown in the VariViggen plans. The SP wings are easier to build and provide increased climb and cruise performance. They also have fuel tanks which increase range to over 600 miles.
Price: $39.50 first class mail, $41.50 air mail overseas.

VARIVIGGEN R/C MODEL PLANS - Complete construction plans for the 18%-size radio-controlled model airplane built & flown to evaluate VariViggen spin characteristics. Designed for 4-channel proportional radio equipment & engine in the .35 to .65-cu. inch size. 555-sq inch wing area. All balsa or foam/balsa construction. A maneuverable flying model with outstanding roll rate. Also shown are modifications required for a control-line model (70-ft lines, .19 to .45-cu inch engines).
Price: $4.75 first class mail, $5.50 air mail overseas.



The following are RAF-authorized distributors of materials and components. Items indicated have been developed under RAF approval and are recommended for VariViggen or VariEze aircraft. Contact the distributors at the address shown for his catalog and description of items. Indicate to him that you are a VariViggen or VariEze builder.



When ordering catalogs from Overseas, please add airmail postage.

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

OR

WICKS AIRCRAFT SUPPLY
1100 5th Street
Highland, Il. 62249
(618) 654-2191

Catalog cost $2 - Refundable at first order.

VariEze materials: epoxies, foams, fiberglass, filler materials, wood, metals, all hardware, specialized tools, skin barrier cream, seat belt/shoulder harness sets, wheels & brakes & custom upholstery/suitcases.
VariViggen materials: spruce kit, plywood kit, hardware, aluminum & fiberglass.

KEN BROCK MANUFACTURING Catalog cost $1 - Refundable at first purchase.
11852 Western Ave.
Stanton, Ca. 90680
(714) 898-4366

VariEze prefabricated components: wing attach/quick disconnect assemblies, nose gear machined parts, control system components, fuel cap assemblies, welded engine mounts, welded stick assembly, welded rudder pedals, wheels & brakes.
VariViggen prefabricated components: all machined parts.

FRED JIRAN GLIDER REPAIR Write for brochure.
Building 6, Mojave Airport
Mojave, Ca. 93501
(805) 824-4558

Send self-addressed stamped envelope.

VariEze prefabricated components: Molded S-glass main gear and nose gear struts, nose gear strut cover, nose gear box.

COWLEY ENTERPRISES Write for brochure.
P.O. Box 14
Santa Paula, Ca. 93060
(805) 525-5829

VariEze plexiglass canopy - Light bronze tint or clear.

H. C. COMMUNICATIONS Write for brochure.
Box 2047
Canoga Park, Ca. 91306

VariEze and VariViggen custom COM & NAV VHF antennaes.

MONNETT EXPERIMENTAL AIRCRAFT, INC. Ask about VariViggen parts
955 Grace St.
Elgin, Il. 60120
(312) 741-2223

VariEze - None
VariViggen - All molded fiberglass parts

GOUGEON BROTHERS Write for brochure.
706 Martin St.
Bay City, Mi. 48706

VariEze - None
VariViggen - 105/206 epoxy and 403 fibers for wood construction.

GEORGE EVANS Contact him for list
4102 Twining
Riverside, Ca. 92509

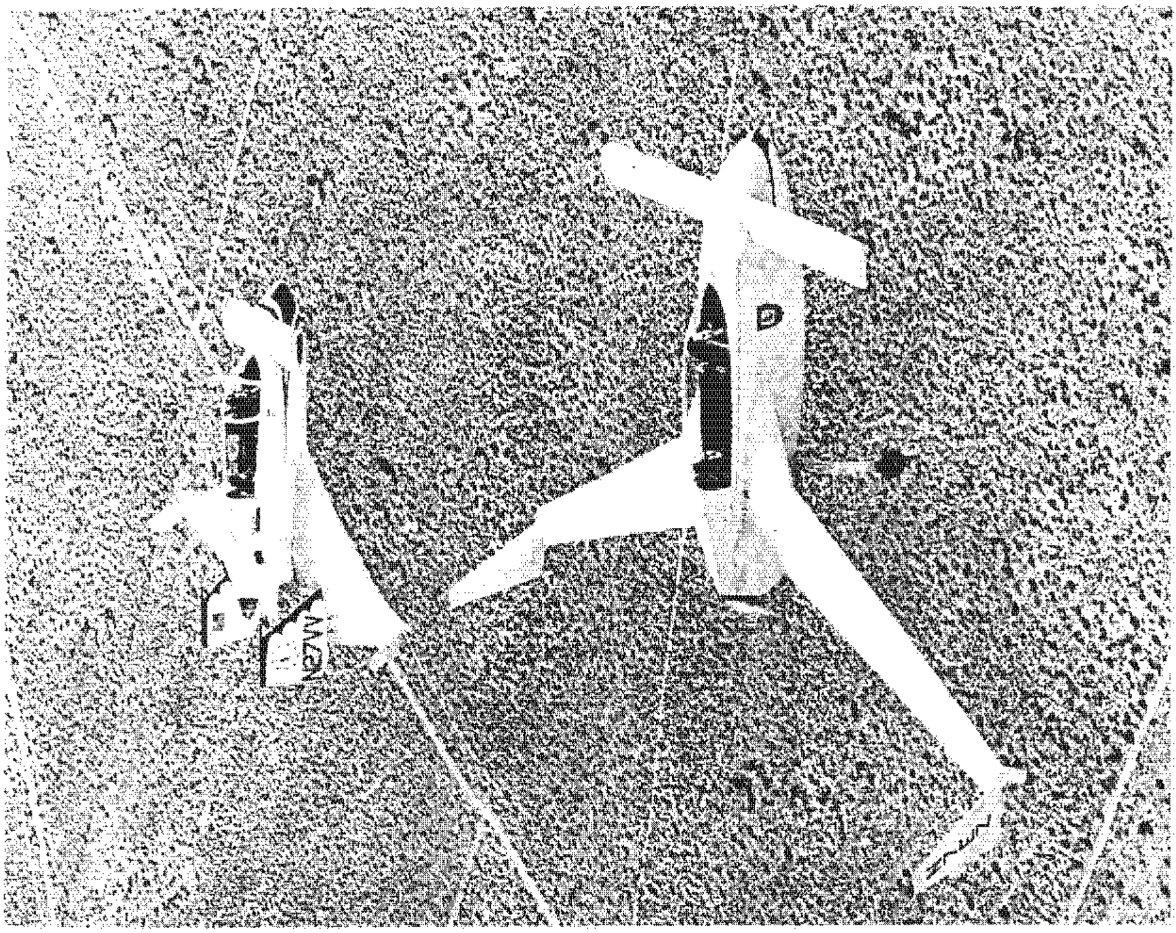
VariEze - None
VariViggen - welded nose and main landing gear, 1-1/4" sq. steel tube.

BILL CAMPBELL (VariViggen builder) Contact him for list.
Box 253
Phelan, Ca. 92371

VariEze - None
VariViggen - Prefab brackets and fittings.

JESSE WRIGHT Contact him for list. (50¢)
7221 S. Colorado Ct.
Littleton, Co. 80122

VariEze - none
VariViggen - prefab wood parts.



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