THE CANARD PUSHER

NO. 13 JULY 77

News of the VariViggen (Very Vig-in) and VariEze (Very Easy)

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If you are building a VariViggen you must have #1 thru current.

If you are building a VariEze you must have #10 thru current.

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RAF ACTIVITY since the April newsletter has included a complete flight-test program on our new aileron-equipped VariEze, support of builders and flyers of the VariEze and VariViggen, two Mojave flight demo days, VariEze trips to the Chino and Watsonville Flyins, check-outs for some VariViggen builders, further structural research, VariEze flying for a movie project, VariEze evaluations by several aviation writers, and development of a homebuilt home-solar water heater.

Except for the VariEze's exhaust system, both the VariEze and VariViggen have been maintenance free since newsletter 12.

You are invited to visit RAF to inspect our airplanes. If you are building, bring parts from your project so we can help with inspection, etc. Our regular hours are 9 to 5 (with a lunch break), Wednesday through Saturday. Builders who need construction assistance may be able to catch us by phone at other times, but we may be in the shop with epoxy up to our armpits, so try to call Wednesday through Saturday if you can.

HOMEBUILDER FLIGHT REPORTS At last count there were eleven VariEze's and one VariViggen flying (not counting the airplanes at RAF). We understand that Bob Conn flew his VariViggen first flight on May 20, but have little information from him. Bob, how about a report for the next newsletter? You VariEze flyers are also a bit tight on info when you are busy on your flight test programs. The following has been gleaned from letters and calls from those now flying. How about a good report from you guys for the next newsletter. As far as we know all VariEze's that have flown are now in current flying status. Maybe some will have restrictions flown off and will make it to Oshkosh.

Peter Krauss, Stuttgart, Germany - Peter has already flown to at least four airshows in three European countries, including the big Paris airshow. Peter reports his first flight was a bit tricky because even though he felt his airframe was straight, it was out-of-trim enough to require rudder to keep things upright (this was with elevons, of course). Second flight on were okay after installing another roll trim tab on the wing. Peter has experienced the same exhaust system cracks as on N4EZ (see later in newsletter) and has modified the exhaust system. He has found, as we have, that the Cleveland brakes are more effective than the Rosenhans and result in less runway required for landing. Peter has done a lot of flying in rain with his VariEze and has noted an unusual phenomenon. Due to the difference in airfoils and loadings of the wing and canard the airplane trims nose up when wet in a rain shower. When rain is encountered you have to hold forward stick pressure and this disappears after the airplane dries out in clear air! Now that the Paris airshow is over Peter has brought his airplane back into the shop to install the ailerons. Incidentally, Peter has produced an 8mm sound movie (in German) covering the construction aspects of his VariEze.

Tony Ebel, Lompoc, California, who we reported on in CP 12 as also having a tricky out-of-trim first flight, is now flying again, this time with ailerons. He reports that he really likes the ailerons and finds the pitch control a bit sensitive. He still has a crooked airframe, particularly the winglets, which results in an out-of-trim condition at high speed, but it is easily controlled now with ailerons.

Lee Herron, New Jersey - "VariEze N1WX flew on Sunday, June 18 for one hour and all went very well. We have a heavy right wing--a trim tab on the left wing has corrected it and she now flies hands-off for thirty-minute periods. All in all--thanks for a great aircraft design. She is fast--outruns everything around here and does everything I ask of her. All the Bonanza owners hate her. We now have 17 hours and will see you in Oshkosh shortly." Lee's airplane has ailerons and a Continental C-90 engine. Lee has noted a 1/8 quart oil loss per hour through the breather. I lose about 1/10 quart per hour on N4EZ. I'm going to try to relocate the breather hose to the top of the starter cover plate, since I suspect that the oil loss occurs only during a steep climb. Lee had earlier damaged his airplane when he made a high-speed taxi test without locking the canopy. The canopy blew open and he had a locked brake due to the use of automotive brake fluid. This swells o-rings and ruins brakes. Use only aircraft brake fluid.

Cy Mehling, Pennsylvania - "Be it known that on the evening of 16 June '77 VariEze S/N 3 lifted off the runway at Doylestown, Pa., flew over the surrounding terrain for about one hour and disrupted every household, picnic, graduation exercises, and all other associated activities in this little town as first eyes turned upward, followed by a mass migration to the airport. This morning it's hard to comprehend that just nine months and twenty days ago those big boxes of foam arrived from Aircraft Spruce. Mary and I send our greetings and heartfelt thanks for the many times you have helped us in the past and an astonishing design for our new airplane." Cy's airplane has an O-200 and ailerons.

Wicks Organ Co., Illinois - N101MW is again flying after its layup to install ailerons. George Gibbons made three flights the first day out and reports he likes the flying qualities, except he felt it was a bit sensitive in pitch until he got used to it. George reported that it was a real strange sensation on his initial tax tests because of the pilot's position out in front of the slim cockpit, but this feeling disappeared after being airborne. George also mentioned that although he made good landings, it was difficult to teach himself to "drive it on" per the Owners Manual instructions, since he had been taught to always make full-stall landings.

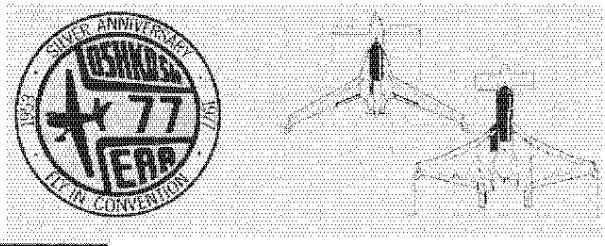
Gordon Olsen, Oregon, flew first flights in April. His highly modified VariEze, powered by a Continental C-85 has reflex adjustable ailerons, a modified tapered canard and a novel instrument panel that lifts with the canopy. Gordon is a competent engineer, using his VariEze for some interesting aerodynamic research.

Kibler/Cowley/Kern, California - The Honda-powered VariEze has been out of flight status lately for some engine updates and installation of ailerons.

As I am writing this I received a call from Johnny Murphy, Florida. His C-90 powered VariEze made its first flight today. Johnny was pleased with handling, had good cooling, and made an uneventful landing. He commented that, like George Gibbons, he had made a full-stall landing even though he was aware of the recommendation to drive it on at 60 kt. During this first flight he experienced an engine failure. He switched the fuel valve to the fuselage tank and the engine immediately restarted. He had not yet checked his fuel system to determine the problem, but he suspects that his Bendix-type carb may require a larger fuel lead. He will, of course, recheck his fuel system and he intends to install the Marvel Schevler carb.

To all those flying, our hearty "congratulations." There are few experiences as exciting as first flights in an airplane you have built with your own hands. Add to that the intrigue aroused by watching your unusual shadow cast on the ground, and the ease at which you can out climb your chase plane and this adds up to one very fulfilling experience!

A comment is in order for those who are, or will, experience pitch sensitivity. Over controlling the airplane in pitch is generally due to the pilot forcefully ham-handing the controls because he is apprehensive and is concerned about "getting behind it" on first flight. A side-stick control is set up for lower control forces than a wheel or center stick, because the arm is rested on the armrest and only the wrist action is used to control. Heavy forces are tiring for a wrist control, thus light forces are designed in. However, if you are flying with your arm off the armrest and using your arm muscles to control the stick, the forces will feel too light. The airplane has excellent damping and stability with hands-off controls. So, rest your forearm on the armrest, use smooth wrist action for control and above all, relax. The VariEze flies smoothly by itself. Smoothly steer it where you want it to go, don't force or jam it back and forth. Of course, pitch forces increase at forward cg. If you are uncomfortable with the forces, move the cg forward until your transition is completed. Also, be sure to use cushions as required to place your head up nearly touching the canopy for the best forward visibility.



OSHKOSH 77 The RAF office will be closed from 25 July to 12 August for our annual Oshkosh, Wisconsin trip for the EAA convention. There will be forums on the VariEze at Oshkosh on 31 July and 5 August. A Variviggen forum will be held on 2 August. Burt Rutan will also give a lecture on flight testing on 4 August. VariEze construction workshops are scheduled for 1 August, 3 August, and 6 August. We will also have our booth open all week--this will be a good place to get your building questions answered since the booth will be manned by active builders. Do bring parts of your project so we can help you with any inspections and better answer your building questions. We should also have a sound movie produced by Ferde Grofe Films. The film shows VariEze, N4EZ, in action, including preflight, taxi, takeoff, mountain flying in some narrow canyons, low-level strafes, landing, etc. Film was shot from the ground, chase car, chase aircraft, and from the VariEze's back seat. Ferde Grofe Films will be marketing the film in Super 8, 16mm, and video cassette for sale and rental. Contact them for price and availability. --18139 West Coastline Drive, Malibu, Ca. 90265.

VARIEZE AILERONS As you know, the VariEze underwent a major control-system design change shortly before newsletter 12. At that time we had made only a few flights with ailerons but were already convinced that they were a very important addition to the airplane. Aileron plans were first available on the first of May and we hope that all serious builders have received them and updated their plans and airplanes to this configuration. If you have plans and do not have the aileron addendum send RAF a 9"x12" envelope with 57 cents postage ($1.50 overseas) and with your address written on the front. Include your aircraft serial number. RAF will stuff your 9 x 12 envelope with the 19-page aileron addendum, thus updating your plans. There is no charge for these.

RAF has gone to considerable expense in developing the aileron system, including (1) a full flight test program revalidating the airplanes performance, flying qualities at all cg's, absence of flutter above the dive speed, absence of spin susceptability and crosswind capability, (2) preparation of drawings and assuring the availability of parts thru distributors, (3) absorbing some of the loss due to obsoleted items (spoiler parts and VECS 5/6).

Of course, the big question is why, why we waited until this late to remove the roll function from the canard and add ailerons for roll?

The reason we did not originally use conventional ailerons is that we were obsessed with the simplicity and low cost of the elevon control system. We knew that it did not provide optimum flying qualities in that the roll rate was sluggish unless rudder were used, and that large aileron deflections resulted in the elevon being deflected far enough to cause a partial stall on the down-going surface. This produced a mildly objectional pitchdown when large aileron inputs were used at low speeds, particularly at forward cg. Installation of the small spoilers on the cowl offset this somewhat, but did not cure the cause. We had assumed that these objections were minor enough to accept and that keeping the simple control system was justified. The fact that the airplane required rudder to maneuver well at low speeds was documented in the Owners Manual, including the requirement for good rudder proficiency for the pilot before being qualified to fly the airplane.

We did not consider the sluggish roll rate to be a flight safety consideration, merely a minor objection that the pilot easily gets used to as he builds his proficiency. Well, to be blunt, the initial homebuilder's experience showed that we were wrong. We found that far too often people just don't do what you tell them to. They don't determine roll trim in a ground-effect flight as the Owners Manual instructs. They fly without roll trim or with a crooked airplane or without the appropriate pilot proficiency. Worse yet, we have found that even small differences in the wing airfoils, winglet angles, or wing twist caused enought out-of-trim that three out of the first six homebuilt VariEzes to fly with elevons found that they had to use rudder just to keep things upright. This being the case, we are forced to make installation of the rear wing ailerons mandatory for everyone.

Now, for the good news. The aileron-equipped VariEze adds some important capabilities to the airplane in addition to its stronger roll authority required to offset an out-of-trim airplane. Returning the strongest roll control to the stick, rather than the rudder pedals made it quite practical to add a rear stick to allow a rear seat passenger to fly home and land in the event of pilot incapacitation. The rear seat stick is included in the aileron plans. The canard control surfaces are now used only for pitch control and thus their effectiveness is not compromised to allow large deflections for roll. As a result, they are much more effective in their role of giving the canard its high lift required at forward cg. Whereas the VariEze used to be limited to pilot weights below 210 lb., the forward limit cg is now extended and pilots weighing up to 255 lb. can be accomodated. The forward cg limit is now based on structural considerations on the nose gear strut;even at forward limit cg of sta 95 the VariEze has more than enough elevator power to rotate the nose before lift-off speed and to flare in-ground-effect.

The aileron-equipped VariEze can now do good conventional sideslips, a maneuver that was very limited with elevons. Sideslips aid forward visibility during steep climbs and greatly increases the airplanes capability to make a good landing in a gusty crosswind.

Most important, the airplane now flies more "conventional", in that roll authority is stronger on the stick rather than the rudder pedals. This should greatly shorten the time required for a pilot to transition to the point where he feels comfortable. We were also concerned that the sluggish roll rate would reflect on the canard configuration in general. A reputation it does not deserve.

Another thing we found through the homebuilders experience was that the spoiler system was unacceptably susceptable to errors in workmanship in installation and rigging. Within the first ten airplanes we inspected we found three who had the spoilers rigged improperly or were rubbing on the cowl! Thus, we were quite pleased to put the entire spoiler system in the trash can where it will never get out of rig or jam on the cowl.

One of the early reasons we were reluctant to incorporate ailerons was our fear of a rear wing flutter mode that may be divergent. This is why we designed the ailerons in the configuration of a full-span mass balance. Flight tests have shown the airplane to be free from flutter. The highest flutter test point was at 240 mph indiated at 10,000 feet, which is a true speed of 280 mph. All controls had deadbeat damping at this speed,thus demonstrating adequate margin over red line speed.

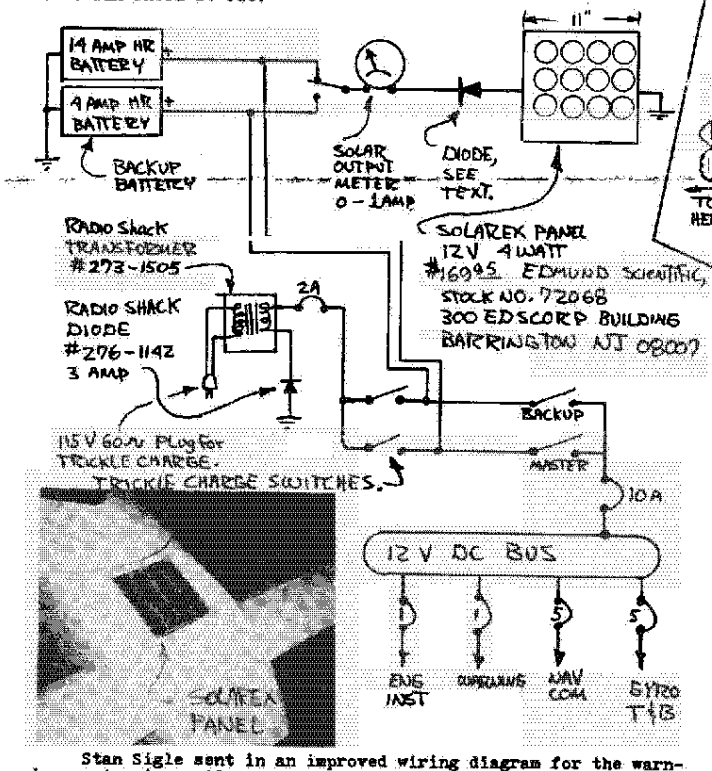
We had previously preached that the "clean wing" of the VariEze (no control surfaces) provided a performance advantage. We were wrong. We have been unable to detect any speed loss due to the installation of the ailerons. In fact, we see a slight increase in corrected performance data, a drag reduction we cannot explain.

In summary, the current configuration (canard elevators for pitch, conventional rear wing ailerons and no spoilers) gives the airplane overall flying qualities we can all be proud of. Roll rate is more rapid than the average light plane, adverse yaw is much less, and flight safety for first-flights/pilot transitions is improved. Those of you who had already fabricated the spoilers and the old configuration stick assembly will have a mild setback in $ and work, but the result is well worth the additional effort. We feel concerned enough about the problems some homebuilders encountered with elevons that we are recommending that inspectors do not approve a VariEze for an airworthiness certificate unless ailerons are installed. The out-of-trim condition on first flight has not yet caused an accident and we want to insure that it never does.

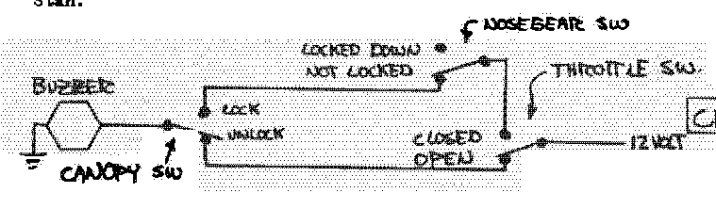
COMPOSITE STRUCTURE DESIGN We receive an occasional question concerning design information and materials properties on composites. An excellent reference is a series of articals written by Hans Neubert and Ralph Kiger published in "Sport Aviation" (EAA) Magazine July 76, Sept. 76, Dec. 76 and April 77.

VARIEZE ELECTRICAL SYSTEM As you know from newsletter 12, we have been testing an electrical system that does not need the engines alternator. We are doing this to alleviate the tail heavy condition caused by use of the heavier engines; O-200 and Lycoming O-235. N4EZ has been flying since January without the alternator and with a trickle charger for overnight charging. We added a backup battery and a solar cell panel in April. Since the solar panel has been added we have not used the trickle charger. We have powered the electrical system only with the sun. The electrical system has one NAV COM, engine instruments, gear warning horn, and one turn-and-bank gyro. The diagram below shows the electrical system now installed in N4EZ. The main advantage is that it keeps all the weight forward, a necessary requirement for the heavy engines. The solar panel is more reliable than an alternator/regulator system. For normal use (see newsletter 12, page 3) the panel supplies more than enough power even if the airplane is hangared. If extended flying is done under cloud cover or if radio or gyro use is higher than normal, the airplane can be plugged into any 110V AC outlet overnight to top off the batteries.

We are using an off-the-shelf solar cell panel as shown, purchased from Edmund Scientific Corp. This panel is made to be bolted on a roof and take all wind loads and is thus too thick and heavy (0.3" and 2 lb) for our application where the panel is bonded to the skin over the instruments (see photo). We have written to three solar cell manufacturers, asking them to build a panel on a thinner back plate for this application. We have not yet received an acceptable offer. In addition to the diode supplied with the panel we added one in series to cut the battery drain in darkness to less than one micro amp. Thus, a switch is not necessary to turn on only when in daylight, the panel is on all the time and charges whenever daylight is available. Unfortunately we do not know the designation of the diode we installed. We tried several from a miscellaneous box sold by Radio Shack and selected one(unmarked) that provided less than 1 micro amp dark drain, while allowing full charge in sunlight. Hopefully one of you reading this can determine an available diode spec and let us know how to call it out. Send the diode so we can check it out.

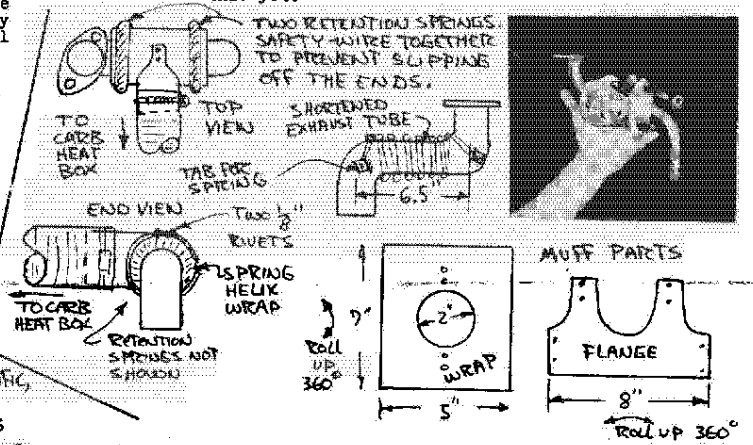


Stan Sigle sent in an improved wiring diagram for the warning system in section III. This system uses the same switches, just rewired. This prevents the gear horn from honking during nose down parking with the master on. It also warns you to not prop the engine if the throttle is open. Normal function of canopy-open warning and gear-up warning is not changed. Thanks, Stan.



VARIEZE EXHAUST SYSTEM As we told you in a previous newsletter, we have been experiencing failures with the exhaust system in the VariEze. These failures show up as cracks in the tubes, generally at the first bend or flange. Since we were using only mild steel automotive exhaust pipe we thought that going to a stainless system would solve the problem. We tested an identical system fabricated with excellent workmanship from type 321 MIL 6737 stainless. This system had failures in two of the tubes within only 12 hours flying! A materials problem is thus ruled out. We have found that the problem is that of resonance- the pipes are of such a length that they vibrate in harmony with the engine and result in fatigue. This is quite common with new systems. We are taking two approaches to solve this problem. The first has been on N4EZ for the last two months, the second is being fabricated and will be tested when available.

1. Shorten the tubes to raise the natural frequency to eliminate the vibration. The left-front tube has been modified as shown. Its 6.5 inch length has been completely wrapped with a spiral of overstretched screen door spring. A simple carb heat muff is made from scrap from your firewall stainless material. This muff is a cylindrical flange for the carb heat hose and a sheet that wraps around the spring-wound tube. The muff is held on with two springs which snugly hold it on to avoid vibration. Carb heat air is drawn in from each end, over the spring coil and into the flange/hose. The other three exhaust tubes are 7-inch straight stacks, exhausting straight down out of the cowl. The advantage of this system is that it's light, cheap and should solve the vibration failure problem. Its disadvantages are that its loud, and cooling air is lost around the clearance holes for all four tubes. Also, it is possible that these stacks are short enough to cause a valve cooling problem, although we have seen no indications of this yet.



2. Develop a quiet muffler system. The vendor that fabricates the system for the Cessna 152 has designed and is now fabricating a compact stainless dual muffler system. It will be quiet and will exhaust aft, such that it will not result in loss of high pressure cooling air. It will require a minor cowling modification involving adding two blisters to the existing cowl. Cost to be determined is, of course, if it will have adequate life in service. We will be doing considerable flying once it's installed to answer the question as soon as possible.

Now, for the big question--what should you do with your exhaust system if you have fabricated it to the dimensions of section IIA? We recommend that you immediately modify it, cut it down as described in 1 above, or at least shorten the horizontal members to 6" or less. This requires four new holes in the lower cowl and patching (4 plies BID) the existing holes. If you are flying the long tubes, carefully inspect them for cracks every five hours until you make the modification. If a tube completely fails and falls off in the cowl, the possibility of engine failure or fire may exist. DO MODIFY YOUR TUBES, ONE E-Z OWNER HAD CRACKS IN ONLY 25 HR FLYING.

COMPOSITE STRUCTURE We have received a couple reports from builders who conducted static tests without knowing the correct method. One builder set his canard tips on two chairs and jumped up and down in the center. He assumed that this could not overstress the canard since the load data indicated it could take four people on each side. He assumed wrong. The bending moment curve in newsletter 10 was greatly exceeded at b.l. 50 where he showed an indication of failure. If you are going to do a static load test assume nothing. Check carefully the loaded bending and shear data. Never apply loads dynamically unless you have means to measure the dynamic load component. Never apply more than 20 pounds per square inch load on any surface with less than four plys skin thickness.

We recently conducted a series of tests to compare shear strength and peel strength of laminates with a variety of glass surface preparations: wet layup, dacron peel ply, dull sand, half dull sand, and no preparation. Test results support our recommendation to use peel ply whereever a glass layup will be done over a cured glass surface. The additional strength obtained by sanding a surface completely dull does not justify strength loss from removing the top ply to do so. A peel-plied surface or a sanded peel-plied surface is best. Full strength of the original surface is maintained and the itch and work of sanding is avoided.

A recent artical stating that one drop of fiberglass resin catalyst in the eye will destroy the eye tissue and result in permanent blindness. The material they were discussing is MEKP, which is a catalyst used in polyester resins, none of which are used on the VariEze. The hardener used in our epoxy resins should be used with appropriate precautions, but does not have the tissue destroying characteristics of the highly toxic MEKP.

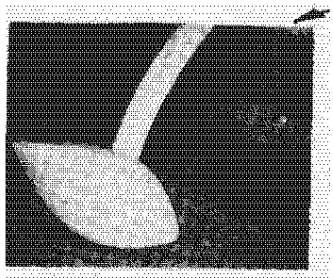
From the information we have been receiving about 70 to 80% of you builders have no reaction to working with the epoxy. About 15 to 20% have a mild reaction such as mild skin rash if skin is not protected or shop not well ventilated. About 5 to 10% have more severe epoxy sensitation, some cases very severe. Those with severe sensitation should not be working with epoxy. The important thing to remember is that the effects are accumulative. If you have no reaction you should still use ply 9 or gloves and good ventilation, since your system will build up to the point where you eventially will become sensitized. Do not be over confident and work with bare hands.

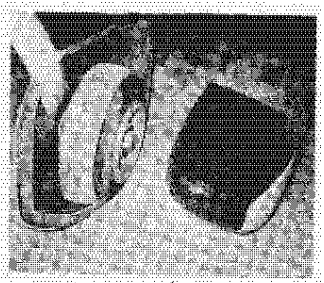
Owens Corning has published some test results of E & S type fiberglass applications for Boeing helicopter rotors. "Our tests show that the loads on a metal blade can cause a barely detectable crack to propagate to catastrophic failures in a few minuets--but because of the materials elasticity and its ability to provide alternate paths of stress, crack formation and propagation are virtually nil with glass composites"---we shot both a metal blade and a glass blade with 23mm shells. After 60 hours the level flight plus maneuver tests the glass blade showed no signs of damage propagation but the metal blade fell apart in three minutes"---"other reinforced composites have not proven as failsafe as glass. For example a bullet hole causing a 5% loss in area will cause a 5% loss of strength in a glass blade, but will cause a 32% loss in a graphite blade and a 43% loss in a boron blade." In 1976, 24 million pounds of glass composites were used in aviation--not including 150,000 pounds for VariEzes!

PROPELLOR EFFICIENCY/VARIEZE PERFORMANCE Propellor efficiency is a concept that confuses the average pilot. This confusion is evident in a lot of the questions people ask us. Molt Taylor's propeller article in the May 77 Aviation magazine contained some misleading and incorrect information that has added to the confusion. While it is true that it is impossible to fly faster than the theoretical helix formed by a propeller, you cannot calculate an airplane's maximum theoretical speed from rpm and the pitch value stamped on your prop. The reason is that most prop manufacturers use the flat bottom of the blade as the pitch reference rather than the zero lift line. On a typical high speed prop of say, 70-inch pitch, the actual theoretical pitch measured at zero lift of the blade section may be as high as 79 inches, and will vary along the blade according to the prop designer's method of twist distribution to load the blade the way he wants. Propeller efficiency is, by definition, thrust horsepower obtained, divided by brake horsepower input, and has no direct relationship to helix slip, as inferred in Molts' article. It is common to obtain values of negative slip as high as eight to nine percent at high speed with any low drag airplane, using propeller manufacturer's pitch values, for example: using a 67-inch pitch Cassidy prop on a VariEze at 9000 ft at 65% power and 2650 rpm, the calculated prop helix speed is 168 mph, but the airplanes true speed is 180 mph. At this flight condition, the prop efficiency is not 107% as inferred by Molt, but the technically correct value of 84%. If the airplane's drag were doubled, the "slip" would go from 107% (180 mph) to about 83% (140 mph) and the prop efficiency would drop from 84% to about 73%.

Since we had printed the rpm vs. airspeed data in newsletter 12 we have found that the tach in N4EZ is not producing accurate readings. We recently tested a new propeller and before making conclusions on it we retested two of the previous props. The data did not agree with previous data. We do not know when the error occurred so we must suspect that the newsletter #12 rpm data may be wrong. We will update it when we get our tach calibrated.

Jiran Pant on N4EZ > CLEVELAND BRAKES 3.50 x 3 x 5 TIRE





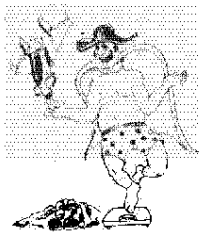
NOTE HOW PANTS SHUT DIAGONALLY —>

We have recently done performance tests with the Jiran wheel pants installed. We have had some difficulty defining the exact performance gained due to some conflicting results in the corrected data. Averaging these it looks like the wheel pant increment at 75% power (full throttle at 8000 feet altitude) is approximately 5 kt (6 mph). This is less than our earlier estimate of 7 kt (8 mph). We have noted what appears to be a 3 mph decrease due to removal of the spinner.

With pants, N4EZ will indicate 150 kt (173 mph) with full throttle at 8000 ft (75% pwr, approx. 2830 rpm). This is a true airspeed of 169 kt (195 mph). At 3000 ft, full throttle True speed is 173 kt (199 mph). These speeds are about 5 kt slower than the data in the Owners Manual, due to a number of items; protruding solar panel, left trimmed rudder, canopy airleaks and exhaust system. The speeds are lower than we expected, but it is still possible for an optimum VariEze to get 200 mph at 75%--Anyone want to race?

Recently checking some more of the Owners Manual data we have found N4EZ capable of exceeding the rate of climb data at high altitudes and somewhat less rate of climb than the book at low altitudes. Takeoff distance data at high density altitudes (7000 ft) is identical to the Owners Manual.

Other performance data for the low horsepower engines was obtained by calculating the static rpm for a 65 hp engine, then setting a throttle position to obtain that rpm. Then flight tests were performed at that throttle setting to estimate 65 BHP performance. In general, the Owners Manual data for 65 BHP was confirmed. We had a race with Fred Woodbridge's Xenoah-powered BD5 and found that we had less takeoff distance, better rate of climb and faster top speed than him, while using only 65 BHP!



VARIEZE WEIGHTS One of the biggest disappointments of the VariEze development has been the continual weight growth. The original prototype N7EZ, which used a 140 lb engine had an estimated empty weight of 385 lb. When N7EZ made its first flight its empty weight was 399 lb. Now, after some modifications, addition of electrical system (radio, gyros, etc) its empty weight is 460 lb. When we originally designed N4EZ for a 173 lb Continental A-75 engine, its estimated empty weight was 480 lb. After incorporating a lot of items demanded by the average homebuilder, adding weight to ease construction in several areas and adapting the 205 lb O-200 with alternator and complete electrical system, N4EZ made its first flight with an empty weight of 570 lb, including an extra heavy paint job. At that time we anticipated that a prudent homebuilder without electrical system could build it as light as 535 lb. N4EZ now weighs about 585 after all its developmental modifications and after removal of alternator.

Our current disappointment is finding that too many builders are loading their airplanes down with extra equipment and heavy finish jobs. They are going to miss the real thrill of flying their EZ at a light weight, and they will find their useful load disappearing. Here is the trap--if you address each item as, "Oh, that's only one/half pound, it's a small percent of the empty weight," you will find that the sum of all the extras will add up, and when you weigh your ready-to-fly airplane you will be scratching your head and saying, "where is it all?" Believe me, it happens every time.

We have a strong recommendation for all of you, and that is to delay installation of any equipment not absolutely required for flight, until after you have flown your airplane a few hours. Then, you will have a much better chance of a successful flight test program--the airplane is easier to fly light and uses less runway. Also, if you make a real bad landing during your transition it will put a lot less stress on your landing gear. Then, if you must, load on the equipment, at least you will get to see first-hand the effect it has on performance and runway requirements.

This philosophy also goes for modifications, too. Don't try something new on your unflown new airplane. Build to the plans first, where you know from our experience that it will work. Fly it that way, then try your modification.

VARIEZE FUEL SYSTEM We continue to be pleased with the three-tank fuel systems operation. Its configuration allows you to use all the wing fuel in level flight and all the fuselage fuel in any normal altitude, as well as give you an extremely accurate indication of the last few gallons. This really takes the apprehension out of a situation where you are stretching the range with low fuel. Be sure you are installing the system as shown in newsletter 11, not the original from section IIA. Also, note the operational comments in newsletter 12, page 5.

As you know, the wing tanks must be vented together to keep even fuel levels. Last month I fueled N4EZ then took off after installing only one fuel cap--I forgot to put one on. In flight, the pressure over the cap hole is very low--this caused all the wing fuel to be drawn into the tank without the cap. After about one hour airborne, all the fuel had been sucked out of the other tank (and the line) and the engine quit. I selected the fuselage tank, got an immediate restart and flew home. With the old system (no fuselage tank) I would have had a forced landing. We have added a visual check of the caps to the takeoff checklist. They are easily seen from the cockpit.

We recently learned that the black polyethylene fittings used in the fuel system are not recommended for use with fuel. The manufacturer recommends PVC or white nylon. The same fittings are available in nylon, so we replaced the ones in N4EZ with nylon. The black polyethylene ones have been in fuel in N4EZ for almost a year with no apparent degradation, so it doesn't look like an immediate problem, but you should replace yours with white nylon next time it's convenient to do so. Aircraft Spruce, Brock, and Wicks now carry white nylon. The affected parts are 0715-020 tee, 0710-162 elbow and 0700-162 adapter.

VARIEZE PLACARDS We have noted that several of the VariEzes we have seen are not adequately placarded. All cockpit controls and switches must be labeled. In addition, we recommend the following information. A convenient placard can be made using small rubon letters (stationary store) on white card-stock, protected with a coat of clear epoxy.

Radio call XXXXX	
Maneuver speed 120 kt (140 mph)	
Gear actuation speed 85 kt (100 mph)	
Max landing brake speed 90 kt (105 mph)	
Max front seat pilot weight XXX lb	
Min front seat pilot weight XXX lb	
No aerobatics No spins	
Takeoff	
Pilot position	Mags
Controls	Carb heat
Trims	Mixture
Instruments	Canopy
Harness	Lift off 60 kt (70 mph)
Fuel - wings	Climb 90 kt (105 mph)
Caps - secure	
Landing	
Mixture	Brake Dn
Gear Dn	Approach 75 kt (85 mph)
Carb heat	Touchdown 60 kt (70 mph)

VARIEZE ENGINES N4EZ, except for the exhaust system, continues to be free of any non-routine engine maintenance. The latest AD on all O-200's (timing change) was complied with. The only input on engines from homebuilders has been two instances of higher-than-normal cylinder head temperatures (over 400°F). If yours is running over 400°, check for baffle leaks. One builder reported temperatures reduced after 10-hours flying. This is common for newly overhauled engines.

By the time you read this, one or two Lycoming O-235 EZs may be flying. If they prove successful, RAF will market installation drawings for this engine ("Section IIC") possibly as early as October.

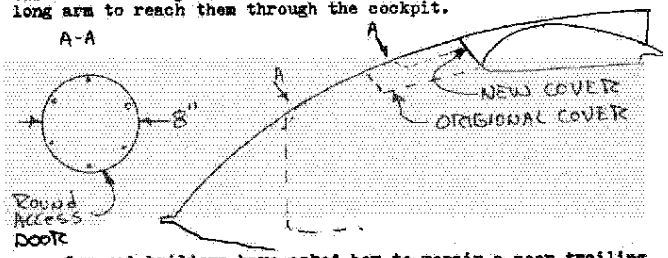
VARIEZE BUILDING HINTS We continue to be asked questions about construction methods that have previously been outlined in newsletters. It is suggested that you note the building hints from all newsletters into the green section of your plans in the appropriate area. Thus, all of this educational material will be in one place for you to review occasionally. It is a good idea to re-read the green section every month or so during your construction project to assure you don't forget an important method or hint.

Again, thanks for the hints turned in by you builders--be sure to send a self-addressed stamped envelope along with your suggestions so we can comment on your ideas.

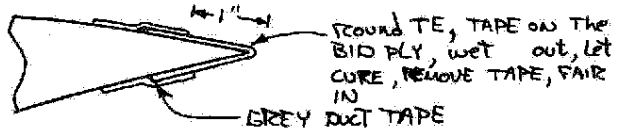
Probably the most troublesome step in the EZ construction has been wings, step 4, page 6-5. There have been a few problems in several areas: 1) it's a long tiring job, ending in an important alignment of several pieces, 2) it covers some glasswork immediately, making it impossible for FAA inspection of vertical shear webs, 3) some builders have not been successful in making a uniform correct thickness layup on the pads in the wing fitting area and have found that they later did not have enough room for the spar cap and skin under the top plate. We are now recommending two improvements that should make this step VariEze. First, layup the 12 and 15-ply BID pads separtely. Do this as follows: lay Saran Wrap on a flat surface, layup (RAES) 1 ply Dacron peel ply, the 12 or 15 plies BID and another ply Dacron peel ply. Cover with Saran Wrap, place a flat block of wood or aluminum and load or clamp with about 50 pound force. Let cure. Trim the cured pads to fit the wing fitting, rounding the edges to allow a smooth shear web layup. Peel the Dacron and bond the pads in place. Be sure they fit flush to the adjacent foam surface. This will assure a straight spar and a pad that is not too thick. The second method change we are recommending is to split step 4 into two separate cures. Stop at the bottom of page 6-5. Peel ply all sides of the box spar. Lay Saran Wrap on a flat surface and set the box on it being sure it is straight while it cures. After cure, peel the Dacron, drill holes for the dowel jigs (see newsletter 12, page 8) and continue with the jigging operation on page 6-6. At this point the aileron cores have been removed from the inboard trailing edge core. Place them back in and hold in position with nails so you will have the straight trailing edge to align the cores in the jig. In summary, an important step has been changed from a long difficult one to three relatively easy ones. Do use the separate-weighted cure method on the four thick pads in the center section spar also--this will avoid a high buildup there.

The lower bolt that holds NG15 to the fiberglass strut must be positioned as shown on page A7. If it is placed in the center of the strut the strut can be split under load. Be sure to use the BID plies here (CP #11, page 4).

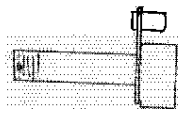
Some have complained about having to remove the canard to service the battery--you're right. I'd suggest moving the canard cover joint aft as shown and add an access panel. The hole should be done similar to the hole in the rear seat bulkhead. The door can be a piece of .025 2024 T-3 aluminum using six #10-32 screws or four camlocks. You might even want to reverse the canard lift tab bolts so they can be reached through the new hole--it takes a long arm to reach them through the cockpit.



Several builders have asked how to repair a poor trailing edge overlap in the canard, wing, or winglet. The method shown below works quite well. The surface is prepared for bond, the dry BID cloth at 45° is taped to one side, wrapped to the other side and taped snugly to pull out wrinkles. Once it is taped down well the BID is wet out with a brush (RAKF) and allowed to cure. Remove the tape (grey duct tape works well) and fair in the edges with 36 grit sandpaper. This method can be used full span on the wing for a super strong trailing edge joint, with a small weight penalty. It is not considered mandatory, though.



It is possible to install the Cleveland brake torque plate assembly incorrectly on the outside of the axle. This will bind the brake. Install it the correct way as shown below.



One builder has suggested using carbon paper to trace a reverse pattern of the templates for the opposite side patterns needed. If you use a copy machine to do this, check for paper shrinkage.

The fittings from Brock have a slightly scored finish on the edges due to the punch operation. Use some 100 grit emery paper to polish these scratches out before installation.

A close study of the cross-section drawings in section V will answer a lot of your questions on finishing.

A Sears #93987 Angle Finder is handy for rigging control surface travel and many other jigging operations.

Another material that works well for hotwire templates is Masonite. Sand the edges smooth and lubricate with pencil lead. The hotwire will slip over the graphite with ease.

Do <u>not</u> use paint removers on an epoxy surface.

Layup time can be excessive if epoxy is only 5-10 degrees cool. Keep epoxy at least 75° for best results--one builder stores resin in a cabinet with a light bulb on.

The nose bumper can work loose due to flexing of the nose gear strut. We have it mounted to the fuselage skin with extra BID plies, immediately forward of the gear, directly under the NG31 bulkhead.

Some builders report that a hot-glue gun is handier than the Bondo in many jigging operations. Also, a pair of electric scissors works well in cutting dry glass cloth.

The Westach RPM gauge wiring works as follows: black to ground, green to magneto and red is unused.

Check the length of the AN509-428-16 screws before countersinking the wing fittings. You should leave the heads a little high, not flush. Better yet, use the AN525's and do not countersink.

You may have trouble with the foam tabs on the main gear bending when you install the glass and clamp. You can substitute 1/4 inch plywood for the foam to prevent this. Do not be concerned about shaving some material from the leading or trailing edge of the gear strut to install the 25-ply outside pad. This will not weaken the gear. It's more important that the pads be laid up <u>straight</u> and not made undersized.

Many builders who previously were taking several times the man-hour estimates, now report they can beat the times, when using all the hints in the last several newsletters.

Truss connector plates--gang-nail devises that secure boards of wood house trusses, make perfect securing devises for foam blocks. Use them to bridge two blocks of foam or shove them into a single block and tie string to it to pull it up to another. Thanks, John Carroll.

Canopy locks <u>must</u> be installed in the correct alignment and engage fully in the positions shown on page 22-10. Adjust so the handle must be forced <u>hard</u> forward to engage the lock while firmly squeezing the rubber canopy seal. This prevents the locks from wearing due to rattling and prevents the canopy from locking when it is closed from the outside. I installed a "drawer lock" ($1.69 at any hardware store) in the fuselage side so I can close the canopy and lock it from the outside with a key. The drawer-engage tab is replaced with a longer aluminum arm shaped to engage the center canopy lock bolt in the closed position. We are using the low density foam rubber weather stripping for a canopy seal. This is the real light material that is about 1/4 inch thick but easily squeezes flat.

If you insist on a capability to open the latched canopy from the outside, install a door on the fuselage side aft of the canopy latch. Wicks did this, and included a key lock in the door.

We have received several comments that the return spring at the rudder is too strong. It is possible that if the hooks are installed short this spring will be far too tight. The only requirement for this spring is to return the rudder to neutral on the ground. Inflight airloads firmly return the rudder. The spring can be lengthened or a lower-rate one substituted. It only needs to be firm enough to overcome friction of the system and the rudder pedal spring. We have selected three different screen door springs available at our local hardware store. The dimensions and spring rates are shown below.

	Outside dia.	Wire dia.	Lb/in for 1" length	Max. force
#1	0.30	0.045	31	20
#2	0.35	0.05	38	30
#3	0.39	0.62	50	35

For the rudder return spring you can use either a 4-1/2 inch length of #1 or a 5-1/2 inch length of #2. Both of these have a spring rate of 6.9 lb/inch.

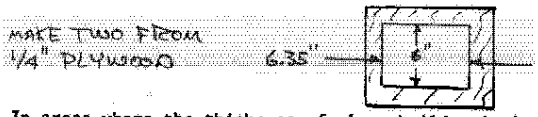
For the elevator trim the upper spring is a 9 inch length of #2, spring rate = 4.2 lb/in. The lower spring is a 13 inch length of #2, spring rate is 3.0 lb/in. If you substitute another spring, be sure to match the approximate spring rate. All lengths mentioned are <u>unstretched</u> length.

R. Godle has turned us on to an epoxy layup roller that works much better than the one suggested earlier. This one has no tendency to lift the cloth and has an excellent stippling action for working out air--we use it on any major layup now. It is called a "3 inch adhesive cover" available at Standard Brands paint stores--stock number 430051, manufacturing number SC251/3V95.

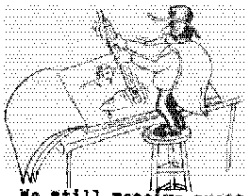
Clarification--the canopy cross brace goes under, not thru, the plexiglass. The plexiglass has <u>no</u> holes on a VariEze installation.

A plywood or metal block bonded to the bottom fuselage skin where the speed brake push rod strikes the skin, will prevent deterioration of the skin edge.

A plywood square mask as shown in the sketch slipped over each end of the centersection spar (step 2, page 8-2), will hold it perfectly square during cure.



In areas where the thickness of glass buildup is important - shear webs, spar caps, pads, etc. - always calculate the thickness (0.013" per ply for BID, 0.009" per ply for UND) and measure the foam core to be sure the foam is the correct size before glassing. The spar cap and skins must make a smooth, straight transition onto the outboard cores (wing and canard). Be sure you <u>fully</u> understand the quality control criteria in "Section I," "Section V ," and newsletter 10.



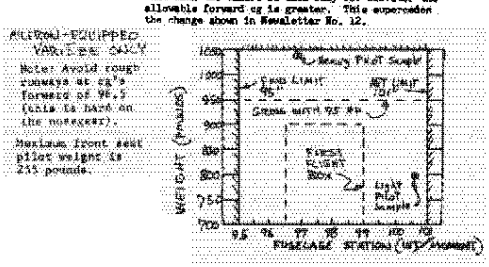
VARIEZE PLAN'S CHANGES We still receive questions regarding changes that have been printed in the newsletters. Be sure to write all plan's changes <u>into your plans</u>, otherwise you may forget and skip them later.

Checklist	Add "check fuel caps" under takeoff checklist
Section I, page 6-5	Photo at top is misleading--method is correct but the part is shaped different--it was from N7EZ.
Newsletter 11, page 7	On the second 22-8 change, the AN509's should be AN525's.
Newsletter 12, page 11	After "ailerons as shown" add the word "below"
Section I, page 22-10	The solid line on the lower drawing of C-7 should be dashed.
Aileron Addendum	6061 T-6 can be substituted for the 2024 T-3 on the 3/4 inch tube.
SECTION IIA	MODIFY EXHAUST AS SHOWN IN THIS NEWSLETTER
NEWSLETTER 11 PAGE 6	ADD "WHITE NYLON" AFTER "TRYAN #EICO 3 PLACES

The following Owners Manual revisions were included in the Aileron Addendum to update the manual for an aileron-equipped airplane. They are repeated here so those non-builders that have section IV can get it updated.

Owners Manual Changes For Aileron-Equipped Varieze

Page 7 5 6	Strike first three sentences under Control System. Add "Pitch is controlled by a full span canard slotted flap providing a large allowable cg range. Roll is controlled by conventional ailerons on the rear wing."
Page 8	After the fifth sentence of Trim Systems - Add "The roll trim system is optional."
Page 13	Strike the following - "If it's a strong crosswind .....the wings."
Page 14	Under "Climb" - Add "The VariEze's excellent sideslipping characteristics allows the pilot to sideslip left and right for required forward viewability during steep climbs.
Page 16	Add "Sideslips can be done on final to lose excess altitude.
	Strike the following - "At pattern speed..... right at home."
	Strike - "Your separate surface.....corrections and maneuvering." Change "third method" to "another method".
Page 18	Strike the second paragraph. Add - Ailerons and rudder are effective at all speeds including full-aft-stick flight."
	Strike the last sentence. Add - "Sideslips can be done at any speed down to and including full aft stick speed."
Page 24	Strike - "A pilot who flies only.....gear during the landing flare.
	Add - "The VariEze has extremely conventional flying qualities. However, its landing speed is 5 to 15 knots faster than most light planes and should not be considered as a training airplane to develop basic flight proficiency."
	Strike - "Once on the ground."
	Strike the last paragraph.
Page 28	Modify the allowable cg diagram as shown. Note that when the canard is used only for elevator the allowable forward cg is greater. This supercedes the change shown in Newsletter No. 12.



Page 29	Change "and elevon" to "elevator and aileron".
	Strike - Elevator Travel Section.
	Add - "Elevator travel 22°±2 trailing edge down and 20°±2 trailing edge up."
	Add "Ailerons must both fair into wing at trailing edge when neutral. At full deflection aileron T.E. must travel 1.9 "±0.3" at outboard end (measure relative to wing T.E)."
Page 30	Change "elevon" to "elevator and aileron" (four places).
Page 40	Change "elevon" to "elevator".
	Change "pushrods" to "pushrod".
Page 47	Add "aileron modification complied with."

Note: The ailerons make no discernable change in performance.

QUESTIONS/ANSWERS

Q: Can you give me the names of those near me building an EZ or VariViggen?
A: No, we do not have the permission of plan's holders to include their name on a public list. Attend your local EAA meeting and ask who is building. A list of EAA Chapters can be obtained from EAA, Box 229, Hales Corners, Wi. 53130.

Q: How many EZ's are under construction?
A: Approximately 1000, worldwide.

Q: What back issues of Canard Pusher do I need if I'm building an airplane?
A: Ten through current for VariEze, one through current for VariViggen.

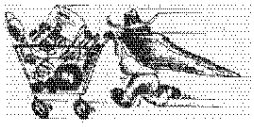
Q: Now that the canard is used only for pitch can I shorten it or use a plain flap instead of the slotted flap?
A: No, changing canard area would move the allowable cg range. The high lift with the slotted flap is required at forward cg. The canard is your main wing, carrying about 25 lb/ft² at forward cg.

Q: What type of respirator is recommended to filter epoxy fumes and foam dust?
A: According to the Mining Enforcement and Safety Administration of the Department of the Interior you should select an approved chemical cartridge respirator. Manufacturers are MSA, Welsh, Willson, Scott, American Optical Corp., 3M, Binks, or Glendale Optical Co.

Q: Since the basic bill-of-materials, page Z-2 of Section I has undergone several revisions can I get a revised one, including all newsletter and aileron changes.
A: Yes, it's in this newsletter.

Q. Looking at the CP 12 data it looks like the Cassidy prop is 10 mph faster. If this is true, why are you now flying the Ted's prop?

A. Many people including you have misinterpreted this data. N4EZ's maximum speed at full throttle is the same with both these props. The Teds merely allows the engine to turn faster. The Cassidy prop has a little better efficiency at top speed, since the same speed is obtained at slightly less BHP. Since the Ted's prop turns more rpm at low speeds it allows more horsepower to be available for takeoff and climb and thus T/O and climb is a little better. The reason I use the Teds is that I rarely cruise at 75% power and don't mind using 2850 rpm to do so. Due to the small diameter prop the tip speed is actually less than with a Cessna at a lower cruise rpm. I generally cruise at 50% power which is a low manifold pressure, but medium rpm, about 2550. The fixed-pitch prop for a fast airplane is a compromise, designed as a climb prop to give adequate takeoff performance. Remember that to get 75% power (75 BHP on an O-200) with a climb prop, you must do so at a higher rpm (lower manifold pressure) than you are used to on your slow light planes. Your engine develops 75% power at full throttle at about 8000 ft.



• Alcor TCP concentrate is now FAA-approved as a fuel additive for Continental and Lycoming nonturbocharged engines to relieve plug fouling caused by 100-octane. TCP was used for years to prevent fouling in airline and military planes' big radial engines. Alcor's mix comes in quart ($3.60) and gallon ($12) cans with a dispenser kit ($2) to measure the correct quantity, which is put directly into your aircraft's fuel tanks. Alcor, 10130 Jones-Maltsberger Road, P.O. Box 32516, San Antonio, Texas.

DISTRIBUTOR STATUS - VARIEZE MATERIALS

Aircraft Spruce and Wicks - Essentially all items are currently in stock. Expect backlog on wheels and brakes. Aircraft Spruce can supply a walkin/pickup order with three-days notice.

Jiran - Immediate delivery on COWL; five weeks on wheel pants and fuel tanks; eight weeks on landing gear and mounted canopy. The unmounted canopy frame is no longer available. When requesting Jiran catalogue send SASE with three-ounce postage.

Brock - '77 catalogue is now out. Landing brake and all aileron prefab parts are now stocked. Brock's backlog is rapidly improving. His backlog was over 10 weeks on some items. It is presently about six weeks. Over 100 nose gear assemblies were shipped the first week in July.

Cowley - Canopies are available on immediate delivery.

EZ PROJECT FOR SALE **We regret to report that EZ builder A.C. Boyles, a professor at Glendale College, suffered a fatal stroke while teaching. A.C. was a capable and well respected EAA designee in the Van Nuys Chapter. A.C. had nearly completed his EZ and his wife, Lucille, now has it up for sale. Price is $12,000.00 including an OSNOH perfectly balanced A-75 engine. The workmanship is superb on this project. Write Lucille Boyles, 15249 Dorian Street, Sylmar, Ca. 91342.**

VARIVIGGEN

VARIVIGGEN PILOT CHECKOUTS As we mentioned in CP 12, N27VV was being made available for pilot checkout of those who have a Viggen nearly completed. We have had three builders come by for this purpose. In each case, we asked them to carefully read the information given in the Owners Manual and newsletter, then give us their comments after the checkout with emphasis on any information that should be passed on to other builders. All three practiced flying from the back seat including pitch control during rapid throttle changes to get used to the trim change. They then got in front and conducted runway flying tests outlined in the Owners Manual and then flew pattern flights. Their comments follow:

Mike Melville - "Burt made the first takeoff and one of the lasting impressions was the sight of the shadow following along in the early morning sun.

Burt demonstrated level flight, slow flight, turns, steep turns, and most important, pitch trim changes with abrupt power changes. This is something that has been emphasized over and over and rightly so. It is an unusual condition, but to be perfectly honest, not a difficult thing to get used to. Personally, I had very little problem with it, however I was thoroughly aware of the condition and I am very current in several different aircraft. This is a point that cannot be too strongly emphasized.

Any person thoroughly checked out and confident in say a Cessna 182, a Grumman Tiger and a tail dragger, in my case a homebuilt Nesmith Cougar, will have no problem with the VariViggen.

After a little stick time in the back seat, we traded seats and I spent quite a while just taxiing the airplane all over the place and let me say this, there cannot be a more simple or manageable airplane anywhere. It is so easy to drive around on the ground and it goes right where you point it, marvelous!

Then I did some high speed taxi runs, again, just point it and go, no problem with keeping it on the centerline, it tracks perfectly straight, and the rudder becomes effective very early in the takeoff run.

Next we tried some nose wheel liftoffs. This must be done in accordance with Burt's instructions in the Owners Manual. Get it stablized at the speed you want, retard the throttle, then rotate. The nose will come up and is very easy to control. I want to emphasize, pitch control is excellent. Before I tried it, I was worried that pitch control may be marginal. However this is not so at all. Pitch control is really great, you can put the nose anywhere you want to and maintain it there.

Then we did a couple of runway flights, liftoffs and flying in ground effect. Again, control is excellent, both pitch and roll, and I felt very happy in it. Full power takeoff was an anticlimax, it was very normal and flew just like any other high performance single engine. Handling qualities in the air are great. It flies perfectly in my opinion, in fact I was very plesantly surprised. It is all I had ever hoped for an more!

The landing, again was almost anticlimatic, with the correct airspeed and altitude, it will land itself. The only thing to remember when landing is not to try to full stall land it as you would a Cessna. It is much better to fly it on, the gear is very forgiving and takes care of most bumps. Don't try to hold the nose gear off right down to a virtual stop, because it will stay up until the canard quits flying and then will fall through rather abruptly. This is no problem, but I personally think that you get a nicer landing by letting the nose down before the canard quits. Also, this gives you better braking, as all the weight will be on the wheels instead of some of the weight being carried on the wings, which it would at the high angles of attack, possible by holding the nose off.

If you try to stall it on, it is possible to hit the tail skids on the runway, so until you get really familiar with the airplane, listen to Burt and fly it on!

To recap: make sure you read and fully understand the Owners Manual on test flights. Then go out and enjoy your Viggen, it is a super airplane."

Burts comments: Mike is a very proficient pilot. He handled the airplane in the first few seconds like he had 100 hours in it. I particularly noticed how well he flew the rudders--must be his Cougar experience. Mike should feel right at home and confident on his first flight in his Viggen.

Charles Allen - "Would like to offer some candid observations on my first flight in N27VV. They are designed, hopefully, to benefit other builders. Also, I hope, of some use to you.

I waited to write until I'd had a chance to fly the G.A. Trainer again, which I did today, and go through some of the maneuvers and fast power changes we made in the VV. I have also read the Owners Manual and found it excellent and complete. Can't find much to add, but after a vivid first impression of the VV, would like to underline a few things.

The first and most important question in a builders mind is, how is a VV different in flight from a conventional small plane, such as the Grumman American Trainer? There is one big difference, and it is explained well in the Owners Manual under "stall characteristics." But I think this difference is so important that it should be spelled out, and emphasized again and again. The difference is that there is a completely opposite pitch-trim change from that in conventional planes, and it is much more severe. Put simply, there is a definite nose pitch-down when power is added, and a definite nose pitch-up when power is reduced. The severity of these pitch changes is proportional to the speed with which power changes are made. Therefore, smooth and gradual changes in throttle settings are essential, especially at low airspeeds. And especially during early liftoffs and flight testing. The elevators are quite capable of correcting these pitch changes, but the pilot used to conventional aircraft could easily be caught by surprise, and not correct promptly. Again, the potential VV pilot should commit this concept to memory, and be alert and mentally prepared when starting out on those first liftoffs.

Another strong first impression I had from both the back seat and the front seat, was that a "high angle of attack" does not seem very high. Therefore, I had a tendency to get into a nose-high full stall attitude when landing. A flatter angle, quoting Burt, is safer and better to use.

Have a few more random impressions of first VV flight.

It is really a thrill to look down and see, for the first time, that wedge-shaped shadow following along!

It's true handling and maneuverability are exceptional. It can be turned on a dime. Visability is outstanding.

Landing gear operation was very smooth. I noticed little difference in trim. The gear feels quite firm and solid on touchdown. And speaking of landing gear, the VV has the greatest ground handling qualities that I can remember, and I date back to WW II. It is a firm, stable, easy to steer, and has perfect visability. A real fun airplane.

Engine noise seemed less than in conventional planes, tho I am not sure of the facts. The Lyc. O-320 responded smoothly and reliably to all kinds of power changes during the flights and on the ground.

Burt's seats didn't fit me too well, but I think seating is an individual thing and must be worked out to each builders satisfaction.

Though the VV and I are hardly acquainted, I think it's love at first flight--and I'm glad I'm building one."

Burts comments: Charles handled the airplane well and was able to fly it straight and level during rapid power changes after only a few seconds practice. I'm confident he would handle his Viggen on his first flight with or without his experience with N27VV.

Harold Reiss - "Decided not to go to see Jim at Phoenix, but rather to head on home and get some work done on 29 HR. I think I'll try to get it ready to fly in prime paint only by the end of July and maybe you'll have some time to come by Urbana, after Oshkosh, and try it out. If not we'll see who does first flights later on.

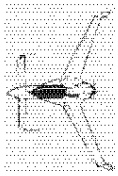
Thanks very much for your time and for the use of 27 VV. It was a real eye opener for me, though I don't feel it is quite as difficult to fly as I led myself to believe, just different in pitch due to power changes. I do feel that it is easy enough to counter if you don't get into a difficult situation such as an emergency go-around before you become accustomed to the reverse pitch change. In a case like that each one of use builders had better be on his toes.

The biggest problem I had, in my opinion, was the high angle of attack during landing. I think this was due to two things. One-the forward visibility, with no engine or prop in front of you, is much better than the average light plane can offer and so gives little to use for reference during landing approach. Two-most pilots were not taught to drive an airplane onto the ground, myself included. It's hard to feel that the nose is still high enough due to that forward picture. However, practice in the VariViggen will overcome this difficulty I am sure.

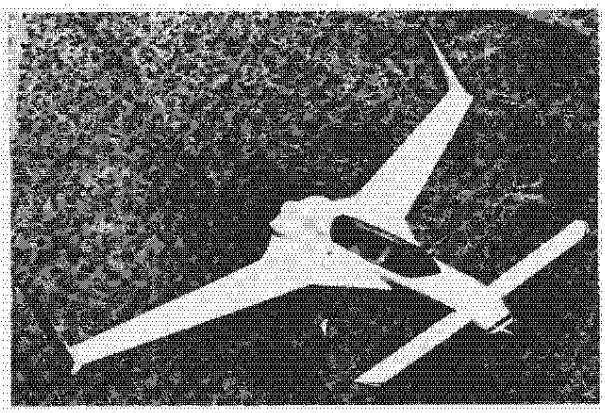
Each builder who plans taxi tests and first flights should, as you said, get good as well as current in several aircraft types. A stick rather than a wheel and conventional gear rather than tri-gear would be best. (I was just barely current in the Arrow and had flown 6 or 7 hours in the last year, besides the trip to Mojave). Ground steering is excellent and low speed during takeoff is about like a 140 Cessna, though a bit easier.

I think your rudder system in 27 VV leaves a little to be desired, as it was very hard to feel the amount of rudder applied. I think the plans built will be much better because of the spring loading at the front rather than the rear pedals, and because it does not have those centering bars. I used rudder but apparently not enough--it seemed as if the pedal got hard after about 1/2 inch of movement. I guess the Arrow with its auto pilot lets a person get somewhat rusty. I have started to clean up my flying and next time I assure you it will be better."

VariEze



TODAY'S HOMEBUILT WITH TOMORROW'S TECHNOLOGY



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

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

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

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
○ Section VI	$10.00	$11.00
○ 3" tri-colored jacket patch	$1.95	$1.95
Add 6% tax if Calif resident - newsletter is not taxable.		
*US. FUNDS ONLY TOTAL		

Rutan Aircraft Factory

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

VARIEZE DOCUMENTATION is available in six sections.

SECTION I - MANUFACTURING MANUAL - This is the complete education manual for composite materials and methods, also, the complete plans and construction manual for the entire VariEze except engine installation. The manual consists of a 153-page, bound, 11"x 17" book plus nine larger full size drawings. It includes 168 photos, over 800 drawings and illustrations, and over 65,000 words. The builder is led, step-by-step through the entire construction of the airplane. The manual identifies sources for all materials and all prefabricated components. NASAD approved

SECTION II - ENGINE INSTALLATION - This is a set of drawings and construction manual for the complete engine installation including mount, baffles, instrumentation, electricals, fuel, exhaust and induction systems, carb heat box and muff, cowling installation, prop and spinner.
SECTION IIA - Continental A65, A75, C85, C90, O-200

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

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

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

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

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

Take Off	900 ft	Range @ Max Cruise	700 mi
Climb	1600 fpm	Range @ Econ Cruise	850 mi
Max Cruise	195 mph	Min Speed (full aft stick)	55 mph
Econ Cruise	165 mph	Landing Distance	900 ft
Empty Weight	560 lb	Wing Span/Area	22.2'/53.6ft^2
Gross Weight	1050 lb	Canard Span/Area	12.5'/13ft^2

SPECS & PERFORMANCE WITH 75-HP CONTINENTAL:

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

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

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

OR

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

All Raw Materials
Catalog costs $2.

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

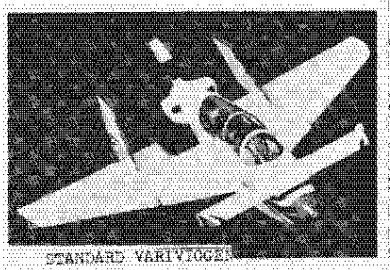
FRED JIRAN GLIDER REPAIR, Bldg 6, Mojave Airport, Mojave, Ca 93501
(805) 824-4558.
Prefabricated components: cowling, fuel tanks, wheel pants, maingear and nosegear struts, strut cover and nosegear box.
Send SASE with 3-oz postage for brochure.

COWLEY ENTERPRISES, Bx 14, Santa Paula, Ca 93060 (805) 525-5829.
Plexiglass canopy.

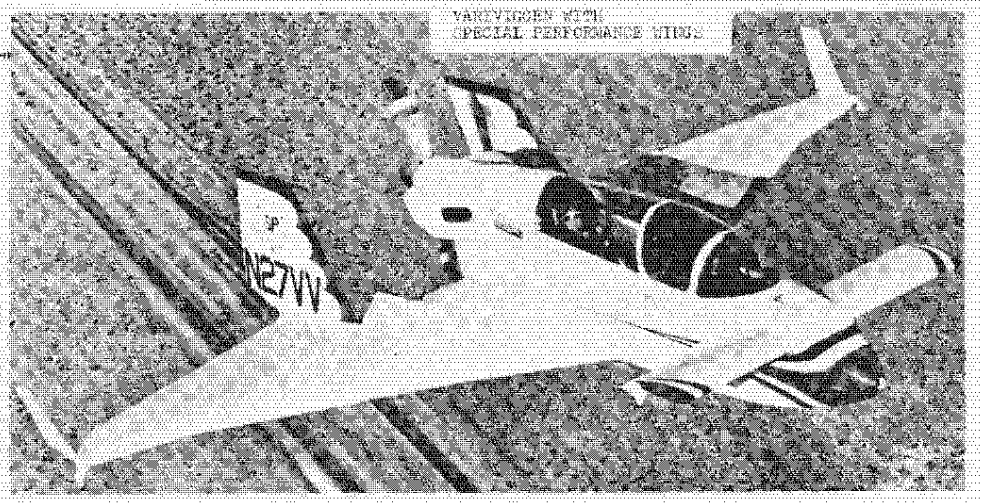
H.C. COMMUNICATIONS, Bx 2047, Canoga Park, Ca 91306, (213) 882-0422.
Custom COM & NAV VHF antennaes.

THANK YOU FOR YOUR INTEREST IN THE VARIVIGGEN

TWO + TWO SPORTPLANE



STANDARD VARIVIGGEN



Performance with 150-hp, fixed-pitch prop, gross weight. Standard VariViggen	Take off	850 ft	Specifications Standard VariViggen	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	Climb	1000 fpm	Specifications Special Performance Wing	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 oustanding 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

THE FOLLOWING DISTRIBUTORS MARKET VARIVIGGEN PARTS:

AIRCRAFT SPRUCE & SPECIALTY CO, 201 W. Truslow, Box 424, Fullerton, Ca. 92632 (714) 870-7551. VariViggen spruce kit, plywood kit, hardware, aluminum and fiberglass. Catalog cost $2.

KEN BROCK MANUFACTURING, 11832 Western Ave, Stanton, Ca. 90680 (714) 898-4366. VariViggen prefabricated components: all machined parts. Catalog costs $2.

THE AIRPLANE FACTORY, 7111-A Brandtvista Ave, Dayton, Oh 45424. VariViggen plexiglass canopy.

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

COUGEON BROTHERS, 706 Martin, Bay City, Mi 48706. VariViggen 105/206 epoxy and 403 fibers for wood construction.

GEORGE EVANS, 4102 Twining, Riverside, Ca 92509. VariViggen welded nose and main landing gear, 1-1/4" sq. steel tube.

BILL CAMPBELL (VariViggen builder), Box 253, Phelan, Ca. 92371 VariViggen prefab brackets and fittings.

JESSE WRIGHT (VariViggen builder), 7221 S. Colorado Ct, Littleton, Co 80122. VariViggen prefab wood parts. Send 50¢ for list.

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.

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.

"I do feel that I can get along with the Viggen well enough to start learning the airplane. I would advise all builders not to get into the airplane, with testing in mind, without a thorough checkout from someone who has become accomplished in a Vari-Viggen. I hope you will emphasize this fact in future publications so that we do not have any bad situations in the future."

Burts comments: Harold's limited flying experience in the last year did show up in that I had the impression that he was not using the rudder pedals and was letting the airplane stray quite a bit before correcting in pitch. It's difficult for me to speculate how well Harold would do on his own first flights. I did help him some on his first couple of landings. I recommended that he get Mike (who lives nearby) or me to help him on his first flights unless he gets proficient in several other airplanes. While he probably would do fine, mixing probable with the other unknowns possible on any airplanes first flight is not recommended particularly considering the years of work and cost involved in a Viggen as pretty as his.

All three pilots flew the airplane with mid reflex, as recommended in newsletter 12.

VARIVIGGEN PLACARDS In addition to labling all switches and cockpit controls we recommend the following placards for Vari-Viggen. Having an abbreviated checklist on the panel is real handy.

Radio call NXXX
Maneuver speed 108 kt (125 mph)
Gear actuation 75 kt (85 mph) one-g only
Max front seat pilot weight XXX lb
Min front seat pilot weight XXX lb
No aerobatics No spins
Solo Front Seat Only

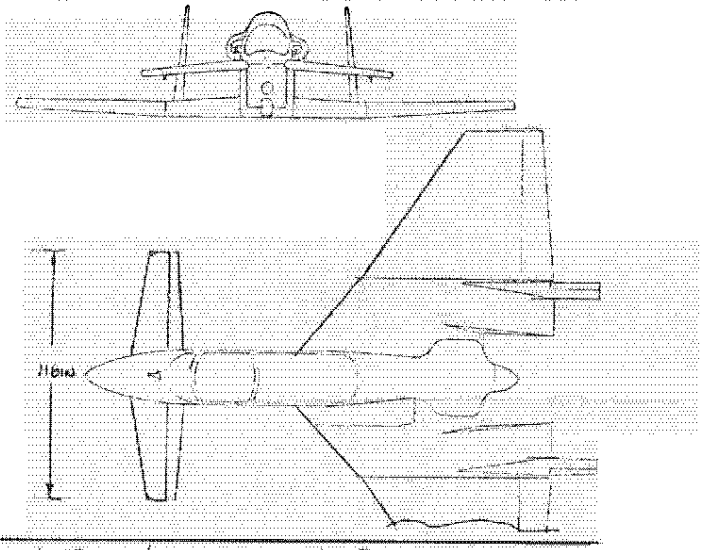
Takeoff		Landing	
Controls	Carb heat	Mixture	Reflex
Reflex	Mixture	Carb heat	Approach 70 kt (80 mph)
Trim	Gear handle	Gear dn	Touchdown 50 kt (60 mph)
Instruments	Canopy		
Harness	Liftoff 60 kt (70 mph)		
Fuel	Climb 75 kt (85 mph)		
Mags			

CAUTION: Trim changes with power--forward stick is required when power is reduced.

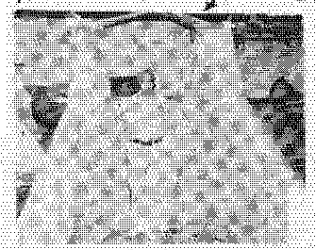
VARIVIGGEN PLANS CHANGES

Owners Manual page 37	Add "never exceed speed (red line) is 175 mph (152 kt) indicated."
SP Plans page 8	Block on inboard of aileron that is 1.3 inches high should be 1.5 inches high.

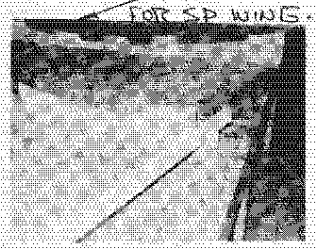
VARIEZE TECHNOLOGY TO BE APPLIED TO VARIVIGGEN Dave Burdette, who is building a VariViggen nearby, has caught the composite bug and asked us to design a glass and foam canard for his Viggen. So, after taking a thorough look at the application, we've decided to also incorporate the high lift airfoil used on the EZ and increase the aspect ratio. This requires less area so the canard had to be tapered to fit the existing bulkheads and control system. Keeping the same elevator pivot at W.L. 18.0 resulted in a need for anhedral to keep the pivot geometry correct for the tapered elevator. The result is a wild looking canard, as you can see from the sketch. We expect to pick up a knot or two of speed and have the same low-speed performance. It should reduce the nose wheel lift-off speed at forward cg. Of course we can't sell plans for this until it can be flight tested. When? Well I'm done trying to guess how long it takes people to finish a VariViggen, but we'll keep you posted in the Canard Pusher.



HAROLD REISS WITH SP WINGS

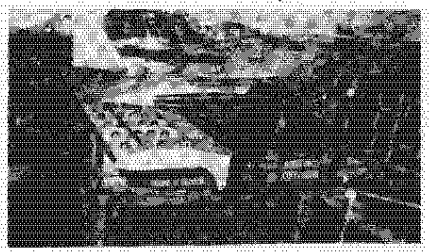


HAROLD'S JIG FOR SP WING.

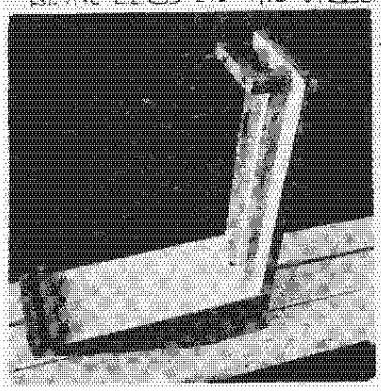


AL LECHIFFLARD'S Viggen in The Jig

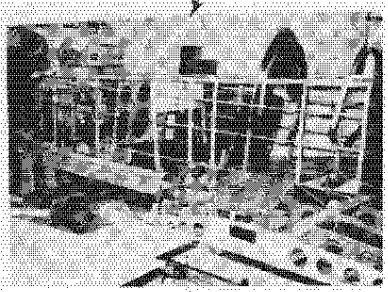
WALLY WARNER'S VIGGEN IN APRIL. HIS IS NOW NEARLY COMPLETE.

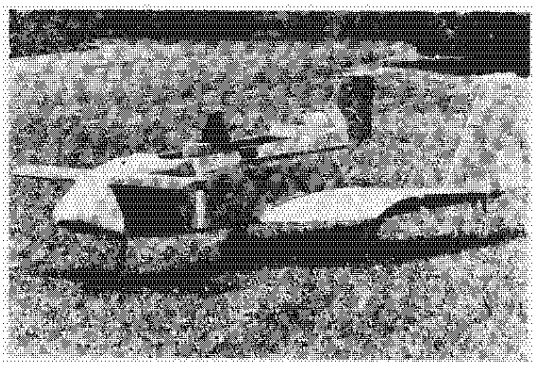


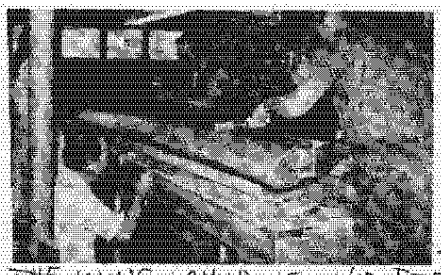
JIG USED BY DR THOMAS DEPALO FOR WELDING MGM BEARE LEGS ON HIS VIGGEN.



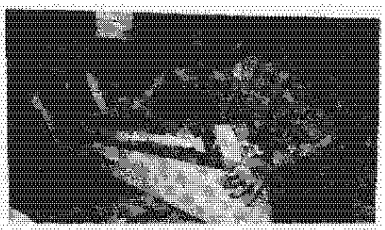
RON SMITH'S VIGGEN IN THE JIG



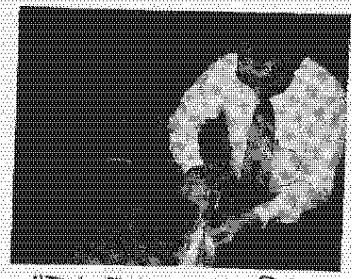




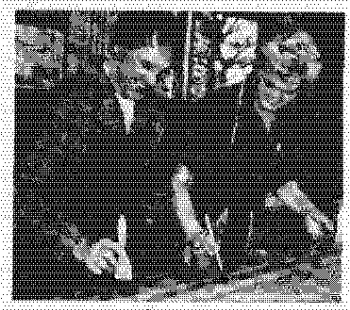
THE WING LAYUP IS VARIEZE WHEN YOU HAVE DR WRIGHT'S CREW



DR JAMES WRIGHT & WIFE DOING THE WING ASSEMBLY.

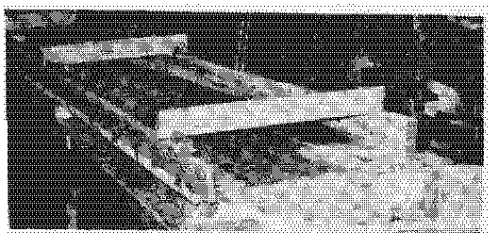


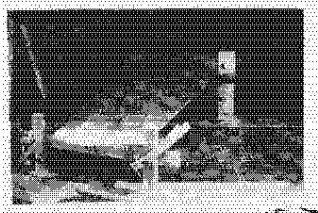
CHECK THIS UNIFORM FOR EZ WORK!!



BRUCE & MARY MUIRHEAD STIPPLING FUSELAGE SIDES. NOTE EZ'S ON APRONS!

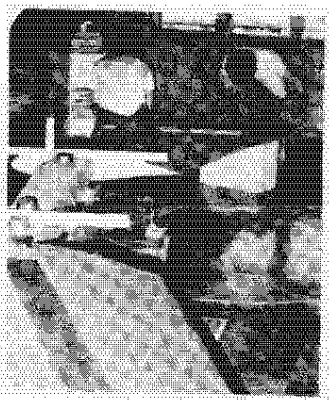
DR WRIGHT'S WING JIG BEFORE BEING FLIPPED OVER →

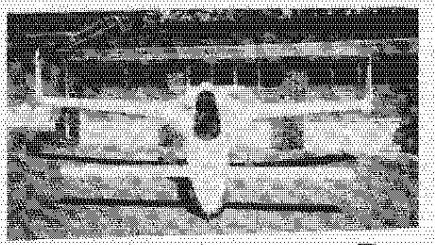




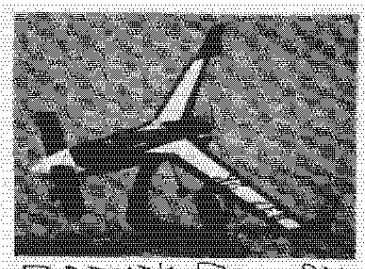
METRIKSENS WING JIG

CHET ELLINGSON REPORTS HE USED A WOOD BOX INSTEAD OF A FOAM BLOCK FOR SUPPORTING THE SPAR DURING WING ALIGNMENT →

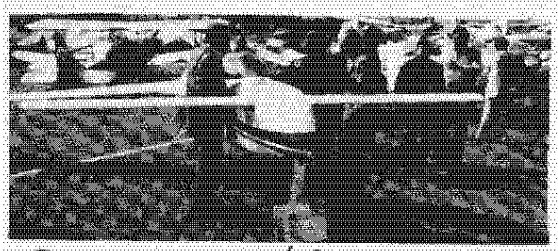




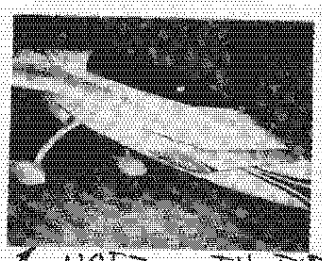
LEE HERRONS EZ AT ROLLOUT



R DEGAE'S RC MODEL BUILT FROM INFO IN THE EZ INFO KIT



PETER KRAUSS' EZ AT THE PARIS AIRSHOW.



N9EZ WITH JTRAN WHEELPANTS

VARIEZE UPDATED BILL OF MATERIALS The basic "Section I" BOM (page 2-2) has undergone several revisions, the major one due to the aileron and backseat stick addition. The following is the current list:

EPOXY: RAEF fast cure epoxy 6 one-gallon kits ✓
RAES slow cure epoxy 7 one-gallon kits
5 minute epoxy 1 two pound kit

FOAM: Rigid PVC
16 lb/ft.^{3}, dark red color, 2 pcs. 60cmx56cmx5mm
16 lb/ft.^{3}, dark red color, 2 pcs. 60cmx30cmx5mm
6 lb/ft.^{3}, light red color, 2 pcs. 90cmx80cmx9mm
6 lb/ft.^{3}, light red color, 2 pcs. 90cmx30cmx9mm
6 lb/ft.^{3}, light red color, 1 pc. 15cmx27cmx25mm

Large-cell expanded polystyrene with flame retardant
2 lb/ft.^{3} light blue color, 4 pcs. 9" x 18" x 67"
2 lb/ft.^{3} light blue color, 1 pc. 9" x 18" x 41"

Rigid polyurethane slab
2 lb/ft.^{3}, Green color, 5 pcs. 1" x 24" x 96"
2 lb/ft.^{3}, Green color, 2 pcs. 2" x 24" x 96"
2 lb/ft.^{3}, Green color, 1 pc. 2" x 24" x 48"

FIBERGLASS: RA5177UND unidirectional weave 70 yds. (38 in)
RA5277BID bi-directional weave 119 yds. (38 in)

FILLER MATERIAL: Flocked cotton fiber, 1 lb.
Microspheres, PF grade inorganic Q-cell, two one-gallon containers.

WOOD: Birch aircraft plywood, 5 ply, 24" x 36" x 1/4"
Spruce or fir, 2 pcs. 1" x 0.7" (rectangular) 105 in.
Spruce or fir, 1 pc. 1" x 0.7" (rectangular) 72 in.
Spruce or fir, 2 pcs. 0.7" x 0.7" (triangular) 105 in.
Spruce or fir, 1 pc. 0.7" x 0.7" (triangular) 72 in.

Aluminum sheet 2024 T3 Clad
.125 thick, 1 piece 110 sq. in.
.063 thick, 1 piece 54 sq. in.
.032 thick, 2 pieces 12 in. X 12 in.
(.040 is acceptable substitute)
.020 thick, 1 piece 72 sq. in.

Aluminum 90-degree angle 2024-T3511
.125 X 1.0 X 1.5, extruded, 2 pieces, 30 in. long
.125 X .875 X .875, " , 2 " , 30 "
(.125 X 1 X 1 acceptable substitute)
.063 X 2 X 2, formed, 2 pieces, 12 in. long

Aluminum Tubing
1/4" OD X .032 wall 3003-O, 4 ft.
3/8 OD X .035 wall 3003-O, 8 ft.
5/16 OD X .065 wall, 2024-T3, 1.0 inch (one inch)
3/8 OD X .028 wall, 2024-T3 or 6061-T6, 2 inches
1/2 OD X .035 wall, 2024-T3, 3 pieces, 47 in. long
1/2 OD X .058 wall, 2024-T3 or 6061-T6, 6 inches
5/16 OD X .049 wall, 2024-T3 or 6061-T6, 4 inches
1¼ OD X .035 wall, 2024-T3 or 6061-T6, 1 piece 66 in.
1 piece 84 in
3/4 OD X .058 wall, 2024-T3, 2 pieces 47½ in. long
OR 6061T6 1 piece 23 in. long

Steel Tubing 4130-N or 1020
3/8 OD X .065 wall, 3.5 inch
5/8 OD X .049 wall, 23 inches

Steel Rod
3/8 OD common steel rod, alloy unimportant, 88 in.
several pieces ok.

Steel Sheet
.016 thick, type 301 or type 302 stainless, 1 piece 24" X 30"
.050 thick, 4130-N or 1020, 1 piece 9" X 2"

HARDWARE
AIRFRAME BOLTS

3/16" Bolts	1/4" Bolts	Misc.
AN3-4A (3)	✓ AN4-5A (4)	AN5-40A (1)
AN3-5A (23)	✓ AN4-6A (8)	AN6-11A (2)
AN3-6A (18)	✓ AN4-7A (12)	
AN3-7A (20)	✓ AN4-10A (4)	
AN3-10A (8)	✓ AN4-11A (2)	
AN3-11A (11)	✓ AN4-12A (7)	
AN3-12A (3)	✓ AN4-14A (24)	
AN3-13A (2)	✓ AN4-15A (1)	
AN3-15A (5)	✓ AN4-17A (2)	
AN3-16A (3)	✓ AN4-20 (2)	
AN3-17A (1)	✓ AN4-40A (2)	
AN3-20A (2)		

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MACHINE SCREWS

10-32 Screws	10-32 Screws	1/4-28 Screws
AN525-10R6 (3)	✓ AN509-10R8 (2)	✓ AN525-416R20 (8)
AN525-10R8 (3)	✓ AN509-10R10 (6)	✓ AN525-416R14 (64)
AN525-10R10 (9)	✓ AN509-10R14 (12)	or
AN509-10R6 (8)	✓ AN509-10R20 (8)	✓ AN509-416R16 (64)
AN509-10R7 (7)	✓ AN509-10R24 (4)	

NUTS:
✓ MS21042-3 (141)
✓ MS21042-4 (65)
✓ AN365-524 (1)
✓ AN315-3 (4)
✓ AN316-6 (1)
✓ AN310-4 (2)

WASHERS:
✓ AN960-10 (100)
✓ AN960-416 (100)
✓ AN960-516 (2)
✓ AN960-1016 (2)
✓ AN970-3 (32)
✓ AN970-4 (12)
✓ AN970-5 (2)

NUTPLATES:
✓ MS21071-4 (2) (ESNA LHTA 57M) (Recessed)
✓ MS21047-3 (6) (ESNA LHTA 51 or KAYNAR K1000-3)
✓ K1000-4 (6)

RIVETS: Hard Aluminum Rivets
✓ AN470AD3-7 (4)
✓ AN470AD4-6 (30)
✓ AN470AD4-10 (28)
✓ AN426AD3-3 (4)
✓ AN426AD3-5 (4)

Cherry Rivets MBP-43 (68)
Cherry Rivets MBC-43 (78)
OR AVEX 16CI-0410
OR AVEX 16C4-0412

CABLE AND CABLE HARDWARE:
✓ 1/16" diameter, 7 x 7 stainless steel control cable, 30 ft.
✓ 3/32" diameter, 7 x 19 galvanized steel control cable, 24 ft.
✓ AN100-3 thimbles (12)
✓ AN100-4 thimbles (12)
✓ 18-1-C sleeve (10)
✓ 18-2-C sleeve (12)

MISCELLANEOUS:
✓ AN210-2A pully (2)
✓ AN271-B10 Universal (1)
✓ AN218-4 (Fafnir BC4W10) belcrank bearing (5)
✓ Fafnir RE4W6 rod end (1)
✓ Heim HM3 rod end (14)
✓ AN393-9 clevis pins (4)
✓ AN416-1 safety pins (4)
✓ AN380-2-2 cotter pins (2)
✓ AN380-2-3 cotter pins (4)
✓ AN380-3-4 cotter pins (2)
✓ AN931-8-13 elastic grommets (2)
✓ MS20001P5 hinge (28 inches)
✓ MS20001P6 hinge (30 inches)
MS20257P2 hinge (12 inches)

✓ 1/8" dia., 1 inch long steel roll pin (1) NAS-561-P-4-16
✓ 3/16" O.D., High pressure .025 Wall Nylaflow tubing (46 ft.)
✓ No. 269-P male elbow for 3/16" OD x 1/8" Nylosaal (4)
✓ No. 20 gauge unshielded airframe electrical wire (40 ft.)
✓ .03 in. asbestos insulating sheet, 6 sq. ft.
✓ 5/16" O.D. x .028 wall fiberglass Arrow stock, 3 pieces 18"
✓ Kraft KPS-1511 two-wire roll trim servo, no feedback
✓ 1/4" Phenolic Sheet, 1 piece, 1½" X 6½"

INSTRUMENTS/INSTRUMENT PLUMBING:
✓ Airspeed (0-220 MPH) --- $ 34.00
✓ Altimeter, Sensitive --- 110.00
✓ Compass, Airpath C-2300-- 24.00
✓ (4 ft.) Tygon tubing 3/8" O.D. x 1/4" I.D.
✓ (1) 0715-153 polyethylene tee (1/8" pipe thd. & barbed hose)
✓ (1) -015 barbed polyethylene tee (barbed hose, all sides)
✓ (2) 0700-153 polyethylene adapter

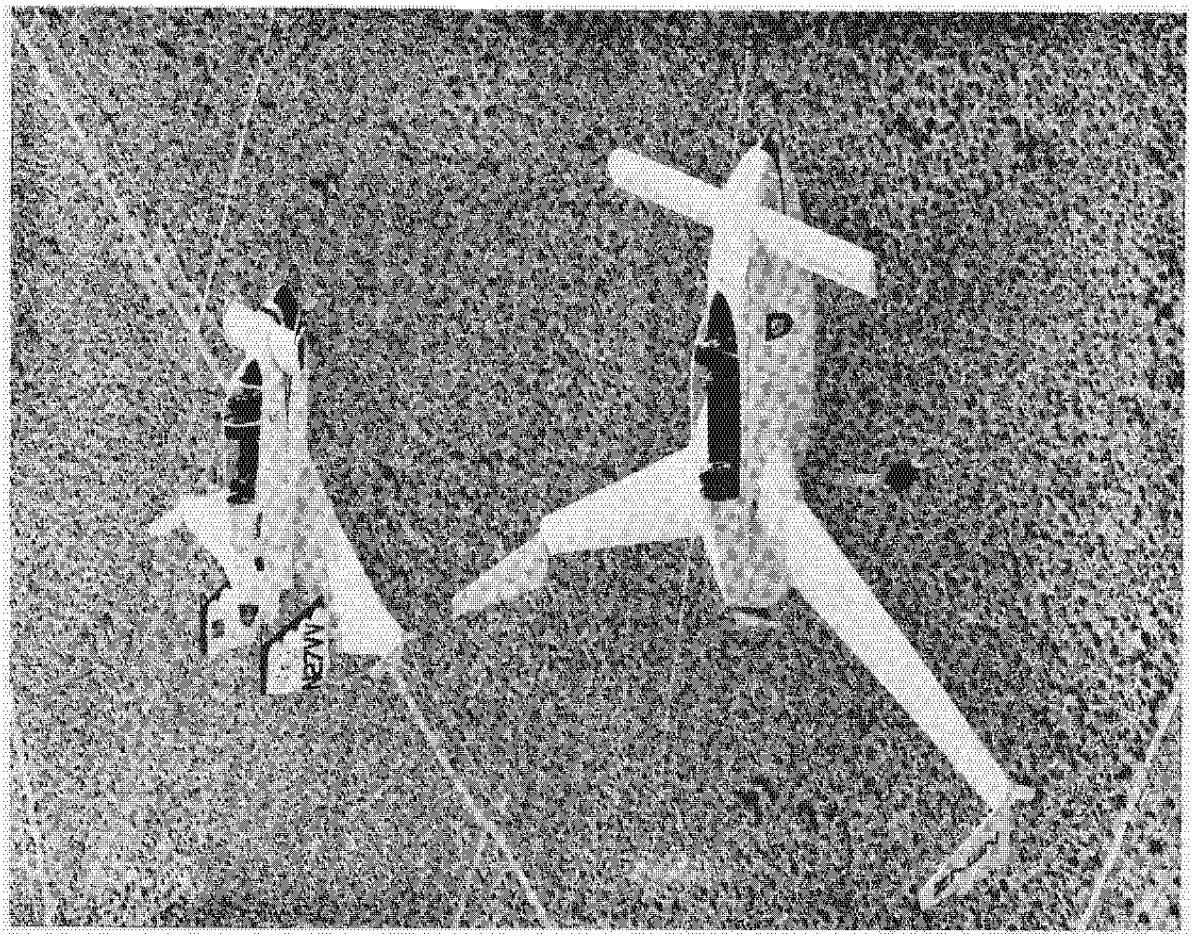
TOOLS
Fly No. 9 Gel Skin Protector, (1 lb.) jar
OR
Disposable co-polymer examination gloves, box of 100
Epo Cleanse, epoxy hand cleaner, (1 pt.)
6-in. long rubber squeegee, (2 ea.)
8 oz. unwaxed paper epoxy mixing cups, Lily No. 8SN1, (100 ea.)
Epoxy layup rollers, (2 ea.)
Bristle Paint brushes, 1-in. wide (50 ea.) and 2-in. wide (50 ea.)
Wood mixing sticks, (box of 500)
Scissors, 1 pair Wiss model 20W
Wood straight edge 1" x 4" x 72", (1 ea.)
Decimal tape measure, Stanley No. 61-112, (1 ea.)

MANUFACTURED ITEMS
Custom upholstery/suit case set including 2 suit cases front and rear seat cushions, and head rests. Color - Cobalt Blue

Light weightcustom adjustable seat belt/shoulder harness set
Cleveland 5-in. wheels and brakes (1 pair)
OR
Rosenhan light weight 5-in. wheels and brakes (1 pair)
Rosenhan reservoir-type brake master cylinder (2)
OR
Gerdes reservoir-type brake master cylinder No. A-049, (2)
** 2.80-2.50-4 4-ply nose gear tire and tube (1 ea.)

3.40-3.00-5 4 ply main gear tires & tubes (2 ea.)
** 4-inch nose wheel with bearings for 3/4" axle (1 ea.)

** These items are not required if the nose gear assy. is purchased from Ken Brock Manufacturing.



Rutan Aircraft Factory
Building 13, Mojave Airport
Mojave, CA 93501

first class mail

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