

# THE CANARD PUSHER

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If you are building a VariViggen from 1st edition plans you must have newsletter 1 through 19. If you are building a VariEze from the second edition plans you must have newsletters 16 through 19. A current subscription for future issues is mandatory for builders, as this is the only formal means to distribute mandatory changes. Reproduction and redistribution of this newsletter is approved and encouraged.

The RAF hangar is located on the west end of the flight line at the Mojave Airport, Mojave, Ca., approximately 80 miles north of Los Angeles. You are welcome to come by and see our aircraft or to bring in any part for our comments. We are normally open from 9:00 to 12:00 and 2:00 to 5:00 on Wednesday through Saturday.

If you are planning a trip to see us, please call first to assure that someone will be here to assist you, since occasionally we are gone to fly-ins.

When writing to RAF always send a stamped, self-addressed envelope along if you have questions. If you are making an order, it's best to keep it separate from a request for an answer to a builder question. Mark the outside of your envelope "builder questions." This will speed our reply.

RAF ACTIVITY since the July Newsletter has involved some new developments in support of VariEze builders. We are now introducing two important new improvements for the VariEze - a wing leading edge cuff to improve stall margin, and a crank-type nose gear actuator.

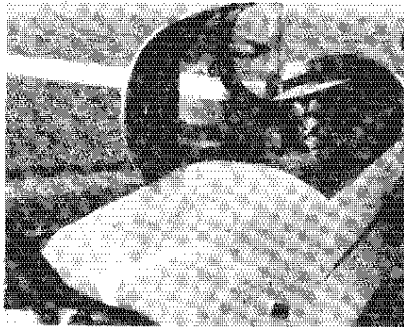
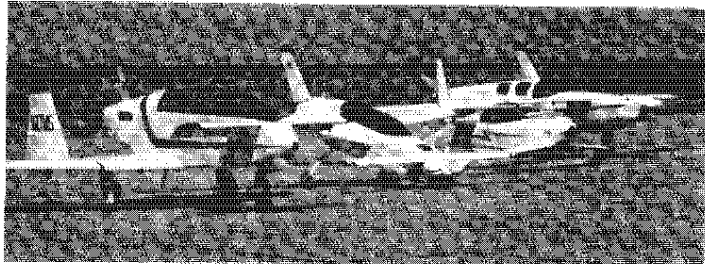
Approximately 25 new VariEzes have taken to the air since the last newsletter. Our prototype, N4EZ now has 400 flight hours.

Our Defiant, VairViggen, and VariEze have all been flown extensively lately, logging about 150 flight hours since October.

The NASA skew-wing AD-1 successfully completed its static load tests. It will be delivered to Edwards Air Force Base next month for research flight tests. This is the first non-homebuilt aircraft to use the structural methods developed for the VariEze. Ames Industrial Corp. should be congratulated for building the AD-1 "on-cost" and "on-schedule". This is rarely accomplished by the large aircraft companies.

THE COMPOSITE WORK SHOP held at RAF on 23rd November, was attended by over 350 people! In addition to the fiberglass education, an airshow was given. It included a Quickie flight demo and a three-ship formation with the Defiant, VariViggen, and VariEze. We hope to make the workshop an annual event.

THE QUICKIE PROTOTYPE now has 250-hr flight time. Tom and Gene report an operating cost of \$3.25-per-hour for the last 14 months, including fuel, oil, maintenance and insurance. Quickie has orders for 185 kits and has delivered 125. About six homebuilt Quickies are nearing completion. Quickie Aircraft Co. plans a seminar tour this spring, flying N77Q to several cities. Details on this will be in the April Quickie newsletter. For the newsletter or any details on Quickie, contact them at Quickie, Bldg. 68, Mojave Airport, Mojave, Ca. 93501 (805) 824-4313.



Bob Hoover, after his flight in the Quickie. Bob also flew the Defiant last October during the Mojave Air Races.

THE SECOND EDITION OF THE VARIVIGGEN PLANS has finally been completed. Our apologies to those who were told it would be available in November. It was just a much larger job than we estimated. Mike has been working over three months on this package now. It includes all the information previously included in the 1st edition plus the two construction manuals, the S.P. wing plans, a new composite "standard" wing section, additional construction hints, the Melville-designed worm drive main gear and our "Moldless Composite Aircraft Construction" book. Of course all improvements incorporated since the beginning have been included. The second edition VariViggen plans are more than double the number of pages of the 1st edition. Many of the parts are now shown as full-size patterns. We expect the 2nd edition from our printer by mid February.

DEFIANT FILM - Ferde Groffe Films is now finishing a new sound movie on the Defiant. Flying for this film was done in December. We understand it is even more spectacular than their Award-winning "Flying is VariEze" film produced in 1977. The new film shows the Defiant being put through its paces including loops, rolls, single engine takeoffs and an exciting comparison of it and a Beech Baron. Ferde is well known for his artistic blending of film and music. The new Defiant film is available from Ferde Groffe Films, 18139 Coastline Drive, Malibu, Ca 90265 (213-454-3886). Write them for purchase or lease terms. It is available in 16 mm and super 8. Prices are similar to the VariEze film.

**DID YOU KNOW** that a 100 hp. VariEze can climb over 25,000 ft. without turbocharging? Dick Rutan flew N4EZ to 25,300ft on November 30 1978. At 25,000 ft it trued out at 125 mph at 2100 rpm and 11 in manifold pressure. At 20,000 ft, maximum speed was 148 mph. Temperature of the cockpit remained 40 degrees above outside, despite the absence of a cockpit heat system. Takeoff gross weight was 890 lb. including 12 gallons fuel and 15 cu.ft. of oxygen. The structure remained below minus 30° C temperature for half-hour. There were no indications of structural deterioration.

On November 7, '78, our Defiant light-twin prototype made a flight to determine its maximum endurance. The airplane was topped off with its normal load of 90.5 gallons and flown solo by Dick Rutan. He took off at 8:47 am and landed at 23 minutes after midnight - a total flight time of 15 hours and 36 minutes! The Defiant's accurate fuel gage system allowed Dick to land with confidence, with only 2.5 gallons of fuel remaining. Both engines were run for the entire flight. The average fuel flow was 2.8 gallons per-hour per-engine, approximately 20% power, 1700rpm and 13 inches manifold pressure. Mixtures were set at peak EGT. Speed ranged from 86 kt indicated at the start to 80kt when low on fuel (maximum endurance speed). Distance traveled was nearly 1400 nm (1610 statute miles). Oil used was 1.1 qt-per-engine. Note that this data was obtained with fixed-pitch props whose efficiency is poor at low speeds. Maximum range at best range speed is about 1480 nm (1700 statute miles), with a light payload. This efficiency is a direct result of the canard arrangement with winglets - giving very low induced drag.

We have service-tested the Defiant prototype extensively and found that it can indeed provide utility not found in conventional aircraft. Examples: Los Angeles to Norfolk Va. with one stop in Dallas, cruising at 17,500ft. Upon arriving at Norfolk we made two practice instrument approaches, landed, flew a 30 minute demo flight loaded with NASA personnel and then fueled the aircraft. 45 minutes of fuel remained! More significant was a trip from El Paso to Los Angeles with 600 lb cabin load, into 45kt to 65 kt headwinds, in cloud and rain for 2 hours and had to climb to above 14,000 ft to shed rime ice. Airports enroute were below IFR minimums. A conventional light twin could not have made that trip. The Defiant landed in Los Angeles with two hours fuel!

**WING CUFF IMPROVES VARIEZE STALLS** As you know from newsletters # 14, 15 and 18, not all the VariEzes flying have reported the safe, departure-free stall characteristics. Several aircraft have reported highly divergent wing rock or an abrupt roll-off into a nose down rolling dive resulting in a large altitude loss, when near full aft stick at aft cg. In late November, Dick was demonstrating stalls, with David Record in the back seat of N4EZ. After showing the stall resistance by level and turning stalls at full aft stick, including sideslips and reversals, Dick let David do some stalls from the back seat. In one of Davids stalls, the airplane abruptly rolled left and appeared to spin one and half-turn before recovering, with a loss of 1200 ft altitude. This, of course was quite a shock, since we had never experienced a departure from controlled flight with our VariEze. A post-flight weighing revealed that the cg was within a half-inch of the aft cg limit.

We then initiated a complete series of new stall/spin tests with N4EZ to try and further quantify its stall resistance. The airplane was ballasted to various cg positions and tufted to visualize airflow. Dick flew the test flights. A summary of the results follows:

The aircraft was totally immune from stall departures or loss-of-control regardless of control inputs or

attitudes or power setting as long as the cg was forward of F.S. 101 (short canard, 142 inch span). The following applies to its characteristics when the cg was aft of F.S. 101: The aircraft was immune from loss-of-control or departure when maneuvered, ie, attempting accelerated stalls. It was also immune during low-energy entries, ie, hammerhead stalls or tailslides. However, occasionally the characteristic wing-rocking motion would diverge and result in a departure to the left within about four cycles of wing rock, at one - g flight. Also, occasionally the airplane would depart in roll to the left without wing rock if the speed was about 48 knots (one-g, level or mild nose-up climb). The departure at first appeared to be entry into a steep spin, since rotations up to one and half "turns" were experienced. Recovery was prompt, as the the stick was pushed forward. We soon realized that the departures were not spins, as the angle-of-attack was rapidly decreasing and the motion was quickly converted into roll, i.e. there was no stable spin mode. To prove this, full pro-spin controls were held in (aft stick, left rudder), rather than attempting recovery.

With these controls held in, the airplane's recovery was just as rapid as when recovery controls were used. Thus, rather than a spin, the aircraft was experiencing a "rolling departure". In military stall testing with fighters, we called these maneuvers "recovery rolls" or "augers".

The good news is, of course, that stable spins were not possible. The bad news is that the aircraft is susceptible to departures with altitude loss as great as 2000 ft when near aft-limit cg. It would be easy to merely brush this off as "normal" and stress the usual training lesson of speed control to avoid stall. We refuse to do this, because we have always been proud of the departure-resistance of a properly-designed canard airplane. Thus, with the help of NASA at Langley Va. we developed a solution. Joe Chambers at NASA had been conducting dynamic wind-tunnel tests with a model of the VariEze. He found that a partial-span drooped "cuff" that extends forward of the leading edge produced a vortex that prevented aft wing stall and eliminated wing rock on the model.

We then did more tests with tufts to verify that, indeed, the departure is caused by aft wing stall. We then installed the cuff - initially 50 inches long, and found that it eliminated departures but did not eliminate wing rock. We then trimmed it to 38 inches long, and found, as NASA predicted, it completely eliminated wing rock and departures. Wing rock induced with the ailerons would damp out after being excited.

At aft limit cg the airplane is as safe as at forward cg. The vortex formed by the sharp edge of the cuff results in the stall angle-of-attack being raised by more than can be expected by the increased droop of the leading edge.

If you have difficulty understanding the above technical discussion, thats ok. Your airplane may already be stall resistant at the aft cg limit in general. However, flight tests and homebuilder experience indicates that it is possible that at aft cg positions, certain conditions could exist where it may be possible to stall the aft wing. A stable spin will not result, but the airplane can roll off to one side and lose considerable altitude.

The end result is that when you install the simple extension to your wing leading edges your airplane should be totally stall resistant at any allowed cg position.

Based on the results of these tests we recommend that you limit your aft cg to forward of F.S. 100.5 for short canard and 99.5 for long canard (see page 27 of your owners manual), until you have installed the leading edge cuffs. Install them exactly as shown on page 6 of this newsletter. Do not modify their shape or round their ends. If you are now building a VariEze, the cuffs can be installed any time after chapter 6. Do not change anything in chapter 6.

The cuffs have been dive tested to 215 knots to verify freedom from flutter. Data also indicate that they provide a small improvement in stability, max speed is degraded slightly - about two knots. Climb and cruise range are not changed.

Do not omit this improvement - do take advantage of the extra work we are doing to provide you with the safest possible airplane.

**NEW SYSTEM SOLVES NOSEGEAR COLLAPSE** - As reported in the "Canard Pusher," several EZ flyers have had their nosegear come out of the lock during taxi or landing. We had traced these to interferences which prevented full NE11 engagement, or improper rigging and snub of NE10, or to incorrect pilot actuation of the system (pushing downward, rather than forward on the knob, bending NG10). However, even though all these items have been covered in the newsletter we still find that many are still experiencing collapse. Damage is generally minimal, but in three instances it has resulted in closing an active runway and the required filing of an FAA incident report.

Being finally convinced that this would continue to be a problem, we have developed and tested a new retraction system. NG11, NG12 and NG13 parts are now obsolete and no longer available from Brock. The new system is being fabricated by Brock. The new system can be easily installed even in a completed airplane. It involves removing the bolts in the NG13 guides, removing NG11 and NG10, installing a worm-drive system in the same bolt holes previously used for NG13. The long NG10 tube is cut down to a short pushrod. The worm is actuated by a 3/8" x .035 aluminum tube extending to a crank on the instrument panel. This gives the pilot a lot more leg room, particularly with the gear up. You will now have room for two small engine instruments in the center console.

Also, the possibility of injury in a crash with the gear up, is probably reduced. For these reasons you should retrofit your completed EZ to the new system, even if you already have the old system installed.

**VARIIZE EXHAUST SYSTEMS** - As you probably know, Ken Brock manufactured VariEze exhaust systems early in our program. His production was halted when it was discovered that that design was cracking due to vibration - induced fatigue, even though our prototype flew approximately 100 hours with this system without problems. Since then, at least ten different configurations have been tested. Some successfully, some failed, and some do not yet have sufficient flight time to judge as successful. The two most reliable so far are shown in the second edition of Section IIA and in CP #18. Most EZ's are using one of these systems. A few EZ's are now flying with a cross-over system that results in rather large, blunt bumps on the lower cowl. As far as we know these are holding up, but the separated airflow on the bumps more than defeats the extra power in drag, and causes high propeller noise. We do not have very much information on this system, as to the number of flight hours etc. We are also interested in learning the operational experience of the other systems now flying. For example, the one at Oshkosh that exited at the cowl T.E. split line. As soon as we can identify an additional system that: (1) is quieter than straight stacks (2) provides at least 90° F carb heat temperature

rise, (3) fits the airplane without excessive drag, (4) can be produced at low cost, (5) weighs less than eight lb., and (6) has been flight tested at least 125 hours without any indication of failure, then we will arrange for it to be produced by Brock for sale to homebuilders. In the mean time we will continue to recommend either the noisy straight stacks or the expensive mufflers. The Flight Research mufflers have been on N4EZ for 17 months and 155 flight hours. They result in a five mph. penalty but are quiet and have had no indication of cracks or degradation.

Please send us any operational experience data you have available on the system you are flying. Describe the system and engine type, any failures or degradation, temperature rise of carb heat system, and number of flight hours.

**ACCIDENTS.** VariEze takes on Cessna 172 at the Cable Airshow, 9 January 1979 - both lost. Gerald Gardner's VairEze was on take off roll and at rotation speed a Cessna 172 pulled out for take off right in front of him. The VariEze rotated abruptly to try to fly over him and almost made it. The EZ's left lower winglet struck the 172's right wing in the flap area, followed by the left main gear hitting the right wing tip of the 172.

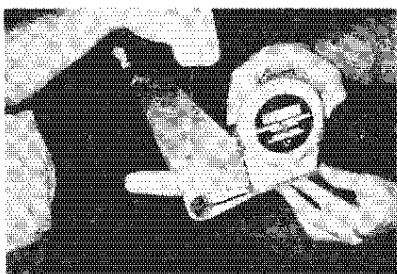
The EZ struck the ground beyond the 172 in a right turn. The canard tip and nose gear hit first, folding the nose gear back.

The canard came off the airplane removing part of F22 bulkhead. The canard and elevators including lift tabs were undamaged. The left lower winglet was damaged. The wing attach fittings were not damaged. The main gear folded back, failing three glass tabs and pulling one aluminum extrusion from the fuselage. The main gear strut was not failed. The right wing trailing edge split open from the aileron to the trim tab. The right winglet failed at midspan. The Cessna's right wing was totaled. There were no injuries. Gerald had 118 hours on his EZ at the time of accident. He said he loves his galactic wonder and will rebuild it.

**CAUTION - FLUTTER** As you should know, control surfaces must be balanced to the proper criteria or flutter is possible. Flutter is a very dangerous thing that usually results in inflight catastrophic structural failure. In the past we have cautioned you to observe balance criteria because we thought it might flutter if unbalanced. Now we know it will. One EZ owner bought a new VariEze from a builder and took his word that all was in order. It had retrofitted wide chord elevators and an elevator trim tab. The builder had failed to rebalance the surfaces, even though he had been reminded to in the last newsletter. The new owner experienced violent flutter while flying at a moderate cruise speed. Luckily, he was able to stop it by forcing the stick aft and reducing power. There was no damage. After the flight he removed the elevators and found they balanced more than 30° nose up, way out of the 10 to 20 degrees nose-heavy requirement. Had the operator followed the owners manual procedure he would have found this before flight. He is very fortunate to be alive.

Many builders have overweight elevators, and then have added the extension, finding that they need excessive balance weight. We have not flight flutter tested an excessively heavy elevator and do not plan to do so. We therefore cannot tell you whether a balanced excessively heavy elevator is safe. It may not be safe. The elevators are a very small part of your airplane, but are the most important and most critical part. Do not accept less than perfection on your elevators. They must be light so that excessive balance is not required. They must be shaped exactly to fit the templates of Newsletter 17, page 11. The adjacent photo shows a wide chord elevator built at RAF this month. It balances 17° nose down without paint and

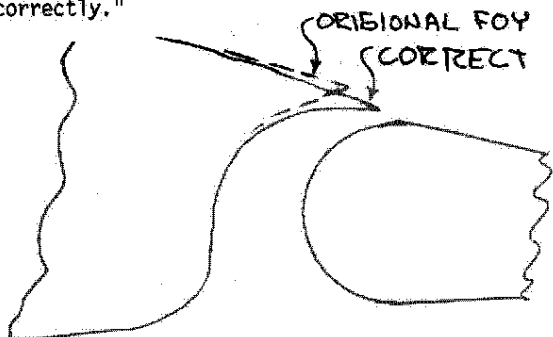
will balance at about 13° with paint. The balance weights are positioned exactly as shown on the plans. No excess weight is required. They weigh 3.3 and 3.6 lb, with weights, ready for paint. If your elevators are overweight or are shaped wrong, strip them down to the bare aluminum tube and rebuild them. That extra work is the most important work you can do on your aircraft. Do not add more than 0.3 lb balance, to correct an overweight elevator.



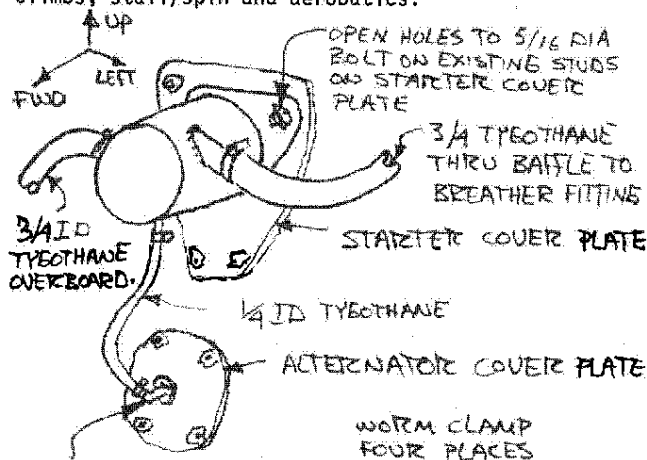
**VARI-EZE BUILDING HINTS.** Cold weather operation hints from Nat Puffer, who has been operating his EZ in -15°F (-26°C) weather. "Direct a hair dryer into the air inlet for one hour before starting engine. 220°F CHT and 120° oil temperature resulted even when the oil tank insulator was used. I closed off half of the airscoop area and now can operate ok with 400° CHT and 145° oil. I must run continuous carb heat for smooth operation"

Also from Nat "modifications that add metal or tools carried in the thigh-support compartment can ruin the normally good performance of COM and NAV antennae"

John Foy, "After being unable to solve my high CHT, I calibrated the probe. At 200° it was within 5°. At 450° it read 520°! To calibrate I used a can of motor oil, heated with a propane torch. Immerse the probe and measure temp with a candy cooking thermometer. The gage was replaced and it now reads ok". More from John "Flight characteristics of our aircraft were not correct. We required a lot of nose up trim at all speeds. The faster we went, the more nose up trim was needed. Also at 20 mph before the stall the nose would come up to the point where nose down elevator would have to be applied. I believe that it was due to the strong nose up trim that was required for level flight. As the speed dropped off, the trim spring authority became the dominant factor. At the stall, back pressure was needed to keep it there and the nose would oscillate up and down, very slowly while the aircraft descended. The aircraft stalled straight ahead with no tendency to fall off on a wing. After talking with you I decided something had to be done to bring the aircraft to normal flight characteristics. We were convinced that our weighing was correct. In your drawings you call for a minimum elevator to canard gap of .1 inches ours was .3 inches. I decided it was too large, so I closed the gap in the full T.E. up elevator position (20 degrees). Now our VariEze responds correctly."



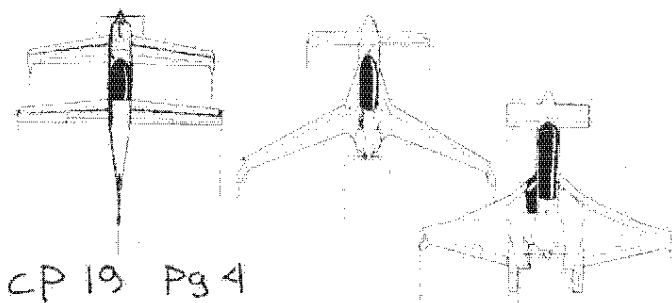
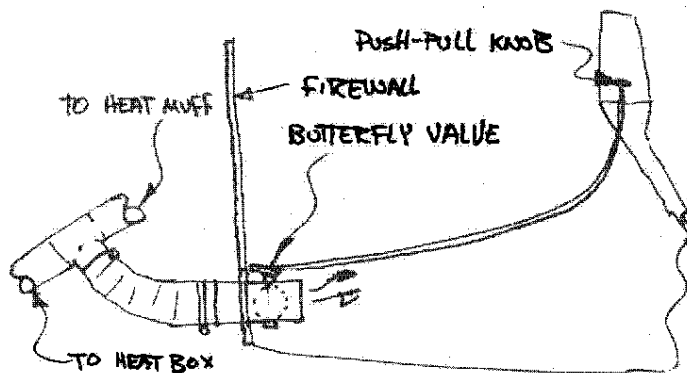
The Following sketch shows the preferred installation of the Aircraft Spruce oil separator. If you still have some oil on the cowl, cut a hole in the separator and stuff it with two "tuffy" plastic cleaning pads, (grocery store). Patch the hole with a plate of .032 aluminum pop-rieveted in place and sealed with ProSeal sealant. This eliminated oil loss on N4EZ even during steep climbs, stall/spin and aerobatics.



AN844-10 FITTING

Jim Ball reports his breather works better when tapped into the top of the starter cover plate, with an internal baffle to deflect gear train-slung oil. He plugs the normal breather.

Lee Herron contributed the following simple low-cost cabin heater. It uses a push pull control at the rollover back to a butterfly valve (made from scrap stainless) at the firewall. A two inch hose runs to a tee in the carb heat line. The heat is merely dumped in the baggage compartment. It flows around passengers' vented-type seat cushion (or it could come through holes in the seat back and forward through the rear armrests). Heat then goes over rollover (defrosting canopy), down around pilot's legs and exits around openings around nose gear. Canopy and main gear must be well sealed. Lee claims it works excellently.



Do not peel ply entire structure. This starves epoxy from lower foam surface, makes inspection difficult, gives an erroneous impression of good surface smoothness, makes it easy to unknowingly damage structure during finishing and adds weight. Do peel ply surface edges of glass plies whenever they exist and, of course, whenever a layup will be later made over a cured surface.

When fitting baffles, be sure to put cowl halves on one at a time, to carefully check for leaks. Metal must be within 3/4" of cowl to prevent rubber seal blow-by. A small rib on the left side attached to the cowl at the trailing edge is usually needed to seal air leakage.

Rosenhan wheels have sharp edges outside rim at three places. Round these to avoid cutting tires. Use only four-ply tires and inflate to 65 psi.

Jim Heitkotter 7327 N. Peach, Clovis Ca 93612, has offered to fly local EZ builders in his EZ to check them out before their first flight. It is a good idea to get an experienced EZ pilot to do your initial testing. Do get some EZ back seat time, if possible.

**VARI-EZE PLANS CHANGES.**

- Owners Manual  
Bottom of page 34      add "are you sure you have complied with all details in appendix I?"
- Section V                      add "Dupont 100s can be substituted for 70s primer"
- Section I  
page 17-5                      AN4-7A should be AN4-10A (4 places). Also add "delete NG10, NG11, NG12, and NG13. Install worm gear retraction system shown in Newsletter 19"
- Section I  
page 2-2                      Revise the parts list to reflect the new nose gear system.  
AN4-7A (12) should be (8)  
AN4-10A (4) should be (8)  
RE4M6 (1) should be (2)  
AN316-6 (1) should be (2)  
AN3-10A (8) should be (9)
- Section I  
page 2-1                      Delete NG10, NG11 and NG13  
Add, worm drive assembly - complete or individual component
- Section IIA  
page 2 2nd Edition              0505-165 should be 0585-165  
0716-202 should be 0716-020  
"polyurethane" should be "nylon" (2 places). Add 3/8 x .035 2024T3 tube 70" long. 5/16 x .035 4130 tube 4" long.
- Owners Manual  
page 27                      Change aft limit cg to FS100.5 (short canard) and FS99.5 (long canard). These restrictions can be lifted after cuffs have been installed and flight tested.
- Section IIA  
page 4                      Oil Pressure gage listed as 287 AM or 287A8 should be 298A8 or 2A8. Delete 103-18 adapter.

**QUESTIONS**

Q. I'm looking for a parachute for my flight testing what do you suggest?  
A. We use a "security," it's only 16 lb and allows a 6'4" pilot to fit the EZ. There are other thin-line type chutes available. Check with the local soaring community. Sailplane pilots nearly always wear a chute and will generally loan you one for your testing.

Q. I have traces of black material coming from my epoxy pump, what now?  
A. This is aluminum from the pump cylinder and is not a problem.

Q. My speed brake retracts at 90 mph even though the springs are tight.  
A. Reduce the off-center distance of the stop for the rod end at the pushrod. It should be stopped at about 1/2" from a straight line drawn between the two pivots.

Q. My resin and hardener appears to have some settling in the bottles. Should I use it?  
A. No, heat a jug of water to about 190 deg. Float the bottles in this jug for 1 hr to warm the resin. Shake the resin bottles. Then keep them stored at room temp. The settling should not re-occur.

Q. I want my EZ to look more like a Defiant. Can I eliminate the lower winglet?  
A. Performance-wise, yes, it only gives about 1% induced drag reduction. But do not leave it off - it protects the rudder and cable in case you drag a wingtip on takeoff on landing.

**DISTRIBUTORS**

FRED JIRAN - recent reduced availability of components is now resolved. Noraml 8-week delivery of landing gear is actually much shorter. Fuel tank orders received by 28 Feb. will be shipped by 31 Mar.

THE AIRPLANE FACTORY, Dayton, now offers 1/2 price replacement for canopy breakage within 3 years.

**NEW PROP**

Proton Manuf. Co., 5595 W. Colorado Pl., Lakewood Co., 80226, (303) 936-1683, makes a VariEze prop for the O-200. Our evaluation shows it to be well built and has good takeoff, climb, and noise level. Maximum speed is about 5 kt slower than the Ted Hendrickson prop.

**FOR SALE**

VariEze N1WX Dragon, by Lee Herron - Designers' Award, Oshkosh 77. See "Sport Aviation," Oct 77 and "Air Progress," Apr 78. 200 Hr TT. Pants, solar cells, mufflers, all mods. Box 357-WOB, West Orange, NJ. 07052 (201) 736-9092 Lee and Dianne are now building a Quickie.  
A-75 engine 100 SMOH, Jim Banks (209) 734-7809, 455-5365 after 5.  
C-85 engine new major. D. Straley, 488 Fairfield, Gretna, La. 70053.  
New O-200A Cont. in factory crates in storage from sky scooter program, \$4,500 outright. Adams, 234 N. Juanita Ave., Los Angeles, Ca 90004 (213) 487-2018.  
A-75 engine 100 SMOH, Jim Banks (209) 734-7809, see at Del Air, Strathmore, Ca.  
Lyc O-235-C, 947 TT logs, \$1300 torn down or \$2500 overhauled. Hal Dunning, Bx 5606, Kirtland AFB, N.M. 87185 (505) 247-8591

Section I  
Chapter 6

add "see CP #19 for addition of stall cuffs on wing leading edges."

**VARIVIGGEN NEWS** -by Mike Melvill

N27MS has flown approx 30 hrs since the last newsletter and is performing flawlessly. Very few builders responded to our request for information on VariViggen; come on guys. How about a first flight report from those of you who are flying? For that matter, we would really like to know how many VariViggen are flying.

I have heard from a couple of builders; Ken Winter has his upside down, and the sides and bottom are skinned and he is applying Dacron. Orville Winfield, and Charles Allen are both building the same main gear retract system as in N27MS, and both report good results so far. Orville has completed his, but not installed it yet, and it looks excellent. Incidentally my system has worked perfectly for 1-1/2 years, 260 hrs and over 320 landings, with no maintenance. While on the subject of the main gear system in my Viggen N27MS, which is now incorporated as the standard system in the new edition of the VariViggen plans, here are a couple of corrections to the parts list and drawings as supplied to those of you who have acquired the drawings for the new gear system from me.

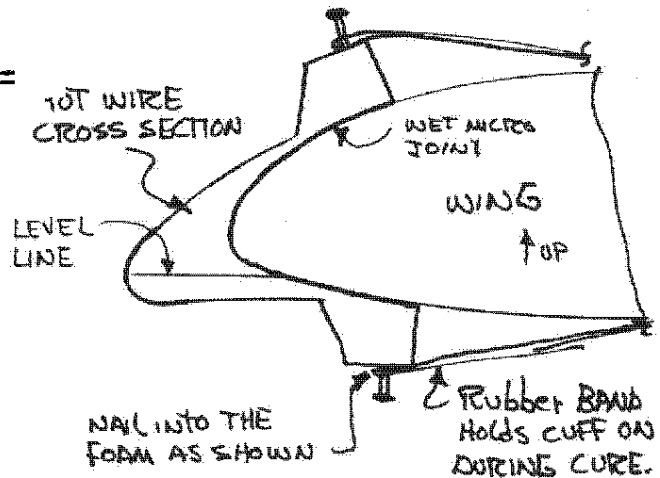
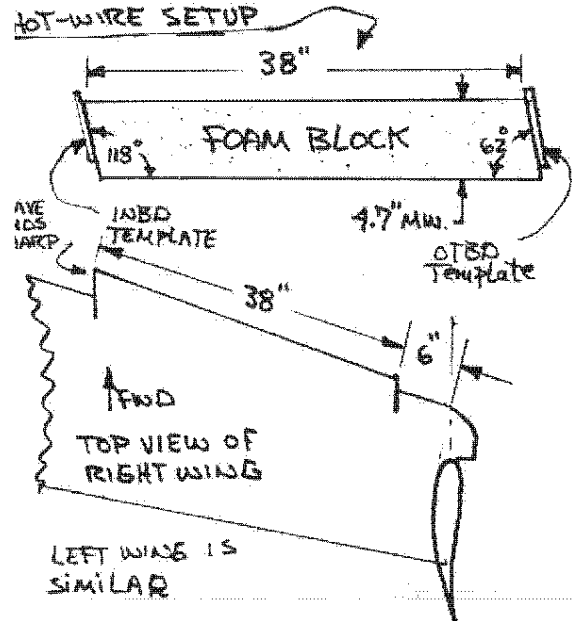
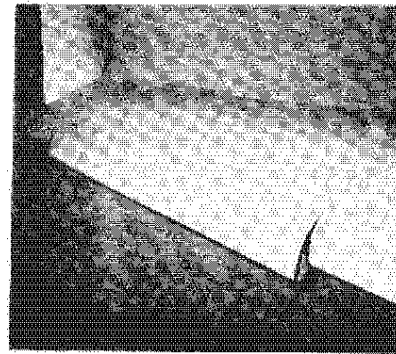
The parts list calls out 4 KP6A bearings; this should be 6 KP6A bearings. Add 2 pcs drill rod 5/16 dia x 4-3/16 long to the material list. On drawing #3, spacer WDG4 should be .340 not .250.

Aircraft Spruce & Specialty are now able to supply all parts reqd for the new main gear retract system. These are not premachined parts, some, such as the CD1145 worm gear will require machining.

The 12" dia spinner (long) available from Rattray, works well on the VariViggen, as it clears the starter better than a 13 or 13-3/4 spinner such as one from a Grumman Tiger.

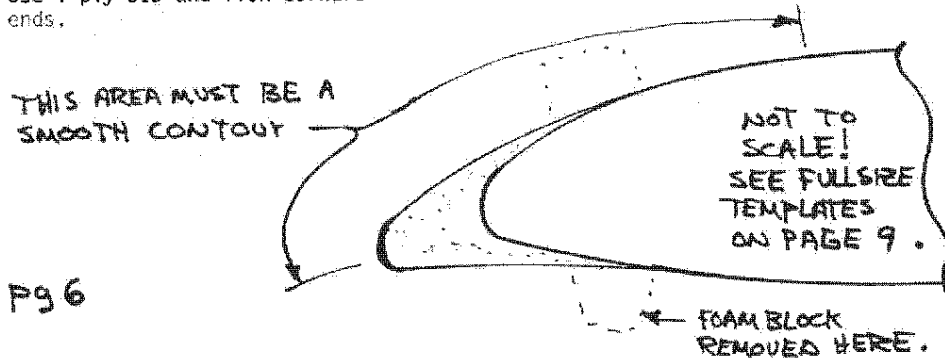
Talked to Jesse Wright, the Viggen builder who supplies pre-cut canard, inboard wing, fuselage bulkhead, and vertical tail kits. I had not seen one of Jessie's kits before and I must say I was impressed with the quality. If I was to do my Viggen project over, I would go with Jessie's kits, just for the time it would save. He also includes a very complete and helpful pamphlet.

Now, for "CP" 20, how about some progress reports? Also, we must try to have at least a couple of Viggens at Oshkosh 79.



**INSTALLATION OF WING CUFFS** - Refer to the sketches.

The cuffs are a cambered leading-edge extension to the wing airfoil. If this is a retrofit, sand the paint off until patches of fiberglass begin to appear. We did not remove the wings to install the cuffs, but it is more convenient to do so. Nail the templates to the foam block and cut one L/H and one R/H cuff. Bond the foam piece to the wing with wet micro. Be sure the waterline is level and the cuff is pulled tightly onto the wing for cure. After cure, carefully remove the excess strips of foam and smoothly contour the shape back over the wing. The surface should not be lumpy or wavy (see "CP" 16, page 4). Glass with 1 ply BID at 45° lapping 1" onto wing skin and peel-ply edges. After cure, apply featherfill or dry micro and sand entire cuff to a smooth contour. Use 1 ply BID and floc corners to cover bare foam at the ends.



CP No 19 Pg 6

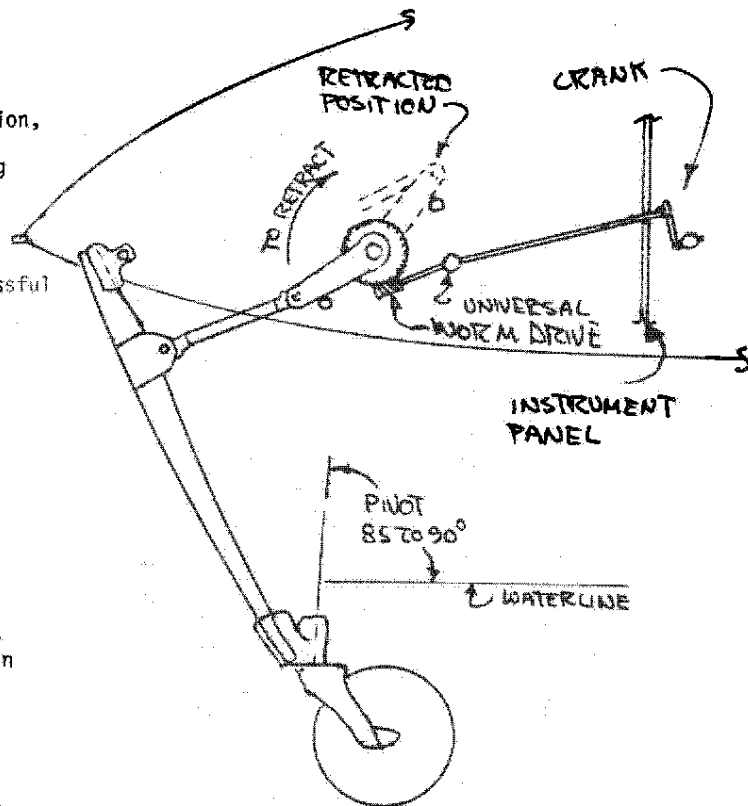


**INSTALLATION & OPERATION OF WORM-DRIVE NOSEGEAR** - The sketches below show the operation of the system. The NG50 arm travel 156°, striking the NG14 spacers at each end of travel. It is over-center in the down position, thus, landing loads are not applied to the worm gear. The pilot's crank uses 10.8 turns for full travel, taking five to seven seconds. Previously you had to slow to 100 mph to extend the gear. You can now extend it at 140 mph, however, the crank is hard to turn above 130. When we first installed this system, we used it to lower the nose with the pilot in the airplane. This was successful until one time when the crank slipped, turned fast, then caught. The inertial loads failed the cast iron worm gear. It is possible that "cranking down" on the ground would be acceptable with the steel gear shown, but this is not recommended.

Use the plans chapter 17 procedure for installing the NG30 bulkheads - The NG14 spacers are the same. If your NG13's are installed, pop them out and bolt in the worm drive assembly. Check the assembly for freedom from binding before installation. It does not have to spin freely, just not bind up enough to make the crank hard to turn. If it binds, loosen the NG57 blocks and shim as required. The NG53 and NG58 gears must be accurately positioned to avoid binding. Use a gear lubricant on NG53 and NG60. Note that four AN960-516 washers are used to position NG58. One at the rollpin end and three at the other end. NG67 is a phenolic block with a  $2\frac{1}{8}$ " hole drilled at a 20° angle. It is fastened to the instrument panel with two #8 screws. Install the crank and tube drilling the hole for the AN3-6A bolt with the crank in the best position to not block an instrument. Now, install the pushrod and adjust its length so the gear is pulled snug up just as NG50 strikes the aft NG14. Extend the gear and accept the down position. If everything is installed properly the pivot for the nosewheel fork will be vertical or canted bottom-forward slightly.

If you want to install a gear warning, mount the microswitch so it is engaged by NG50 or NG9 in its last 1/16" travel.

If you want to mount small instruments in the center piece, back-mount them. Make the hole in the panel 1.8" diameter maximum to leave sufficient panel stiffness.



SEE NEXT TWO PAGES FOR DRAWINGS.

**NOSEGEAR WORM DRIVE PARTS LIST**

| No Reqd. | Part No. | Material  |
|----------|----------|---|
| 2        | NG50     | .125 4130N steel  |
| 2        | NG51     | .250 2024T3 alum  |
| 1        | NG52     | 5/8 O.D. x .095 x 3" long 4130N tube                    |
| 1        | NG53     | Boston gear CD1145-machining is required                |
| 2        | NG54     | Boston bushing FB1012-4                                 |
| 1        | NG55     | 3/4" O.D. x .058 wall x 5/16" long 4130N tube           |
| 1        | NG56     | .125 2024T3 alum 2" O.D. x 1 1/4" I.D. x .125 THICK     |
| 2        | NG57     | 1/4" x 1/2" x 1" 2024T3 alum bar                        |
| 1        | NG58     | Boston worm HDVH  |
| 1        | NG59     | MS20271B8 universal                                     |
| 1        | NG60     | 5/16" O.D. drill rod 3 1/2" long                        |
| 1        | NG61     | 3/8" O.D. x .035 wall x 18" long 2024T3                 |
| 2        | NG62     | 1/2" O.D. x 1/2" I.D. x .250 long 2024T3 alum           |
| 1        | NG63     | 3/8" O.D. x 5/16" I.D. x 1 1/2" long 4130N steel sleeve |
| 1        | NG64     | .062 4130N steel crank                                  |
| 1        | NG65     | 5/16" O.D. x .035 wall x 2-1/8" long 4130N tube         |
| 1        | NG66     | Macromé wood bead handle                                |
| 1        | NG67     | Phenolic block 1/2" x 1" x 1 1/2"                       |
| 1        | NG68     | 1/2" O.D. x .028 wall x 3/4" long 4130N steel tube      |

**NEW EPOXY REDUCES SENSITIVITY**

WE have been testing a new epoxy system that is a new development by Applied Plastics. It is formulated from completely different materials, resulting in a toxicity rating of SPI0, rather than SPI2 of normal epoxies. It promises to result in dramatically reducing the incidence of epoxy allergy. Also, its peel strength, exotherm, and water absorption is improved from RAE. In order to determine its actual toxicity under the conditions of VariEze construction, Applied Plastics plans to send samples of the new material to selected homebuilders who have experienced predictable rash when using the normal epoxy. If you have a sensitivity problem that prevents you from using RAE, send us a short letter, describing your symptoms, willingness to try the new system, and to report on its results. We will select a dozen individuals and provide them with samples to try.

SIDE VIEW  
FWD  
UP

1/4" DIA HOLES  
4 PLACES, DRILL TO  
MATCH ORIGINAL NG13.

INST.  
PANEL BRACKET

TO TRIM SUPPORT  
CENTERED IN RESEAL

TOP VIEW  
FWD

SECTION A-A  
2 PLACES

RE4-M6  
2 PLACES.

0.62 4.1304 OR 1020  
STIFFENER  
WELDED BETWEEN  
NG50'S

THIS BOLT IS  
SPACED ON RIGHT  
SIDE DUE TO CONTACT  
WITH CD115 GEAR

1/8" DIA  
ROLL PIN

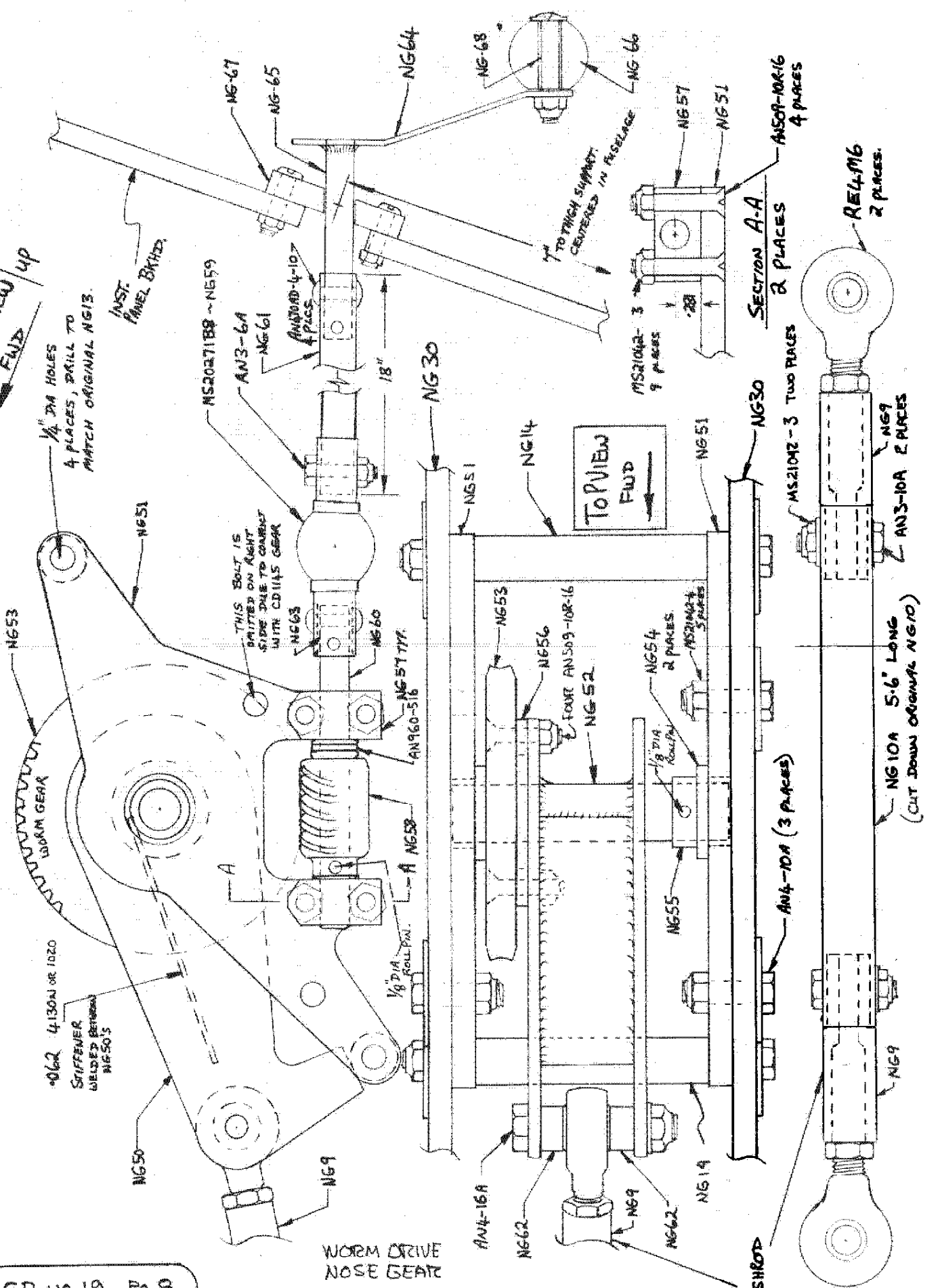
FOUR AN509-10R-16  
NG 52

AN4-10A (3 PLACES)

NG 10A 5.6" LONG  
(CUT DOWN ORIGINAL NG10)

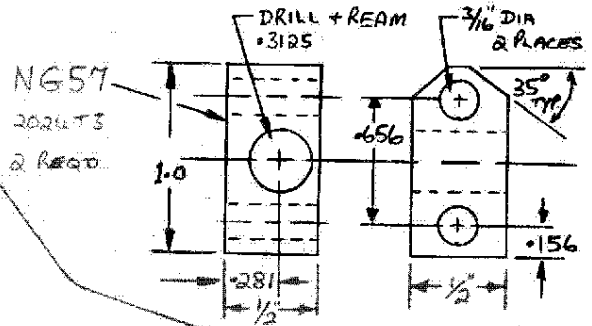
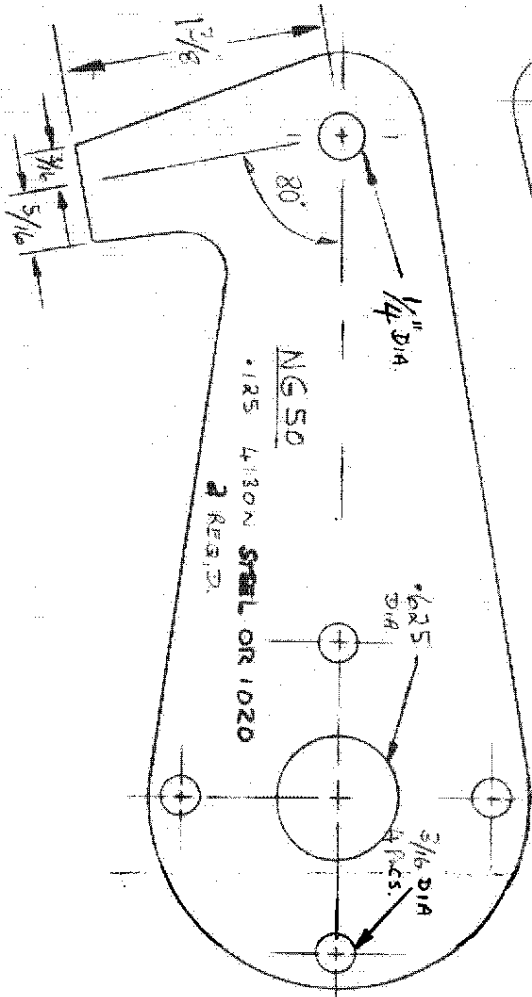
WORM DRIVE  
NOSE GEAR

PUSHROD





# FULL SIZE



NG51

.250 THICK 2024-T3 ALUM.

2 REQD.

.750

1/8

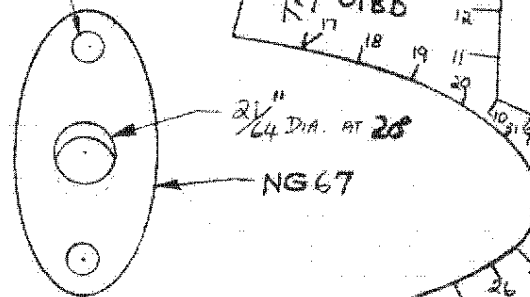
1/2

1/2

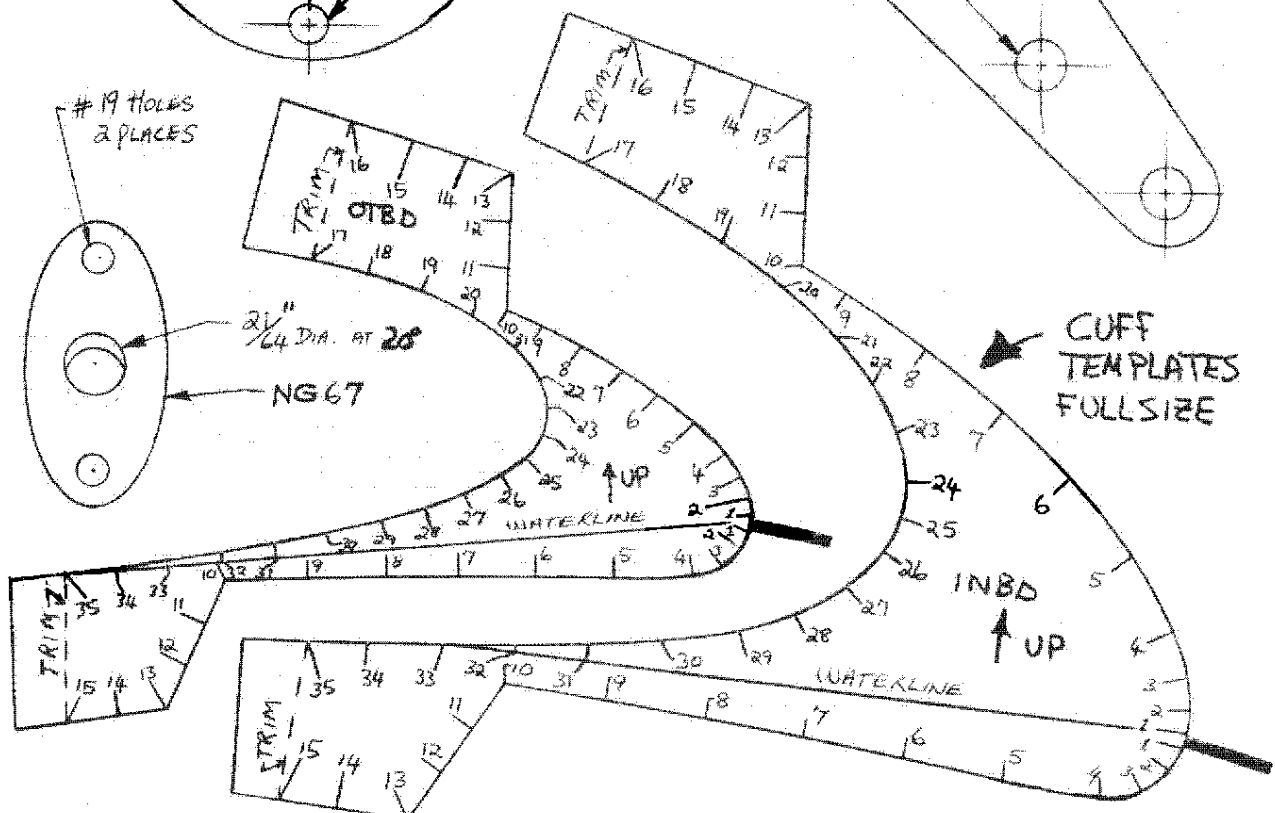
1/2

1/4 DIA 4 PLACES.  
DRILL TO MATCH NG13

#19 HOLES  
2 PLACES

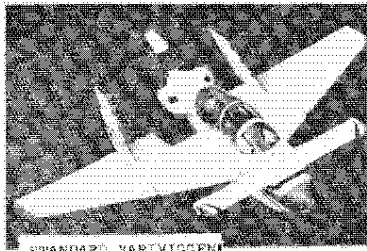


CUFF  
TEMPLATES  
FULLSIZE

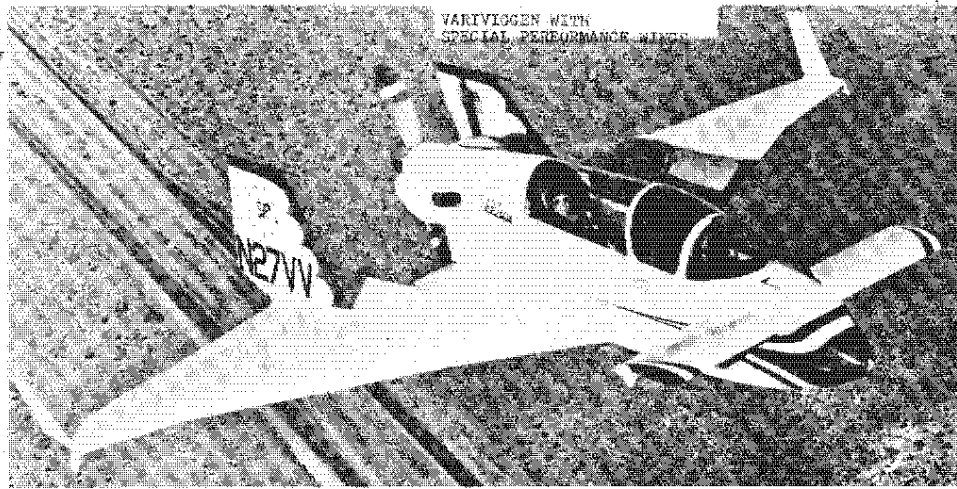


**THANK YOU** FOR YOUR INTEREST IN THE  
**VARIVIGGEN**

TWO + TWO SPORTPLANE



STANDARD VARIVIGGEN



VARIVIGGEN WITH SPECIAL PERFORMANCE WINGS

|   |  |  |   |  |   |
|---|--|--|---|--|---|
| Performance with 150-hp, fixed-pitch prop, gross weight: <b>Standard VariViggen</b> | Take off<br>Climb<br>Cruise<br>Full aft stick<br>Landing | 850 ft<br>600 fpm<br>150 mph<br>49 mph<br>500 ft | Specifications<br><b>Standard VariViggen</b>      | Canard Span/Area<br>Wing Span/Area<br>Empty Weight<br>Gross Weight | 8 ft/18.3 ft <sup>2</sup><br>19 ft/119 ft <sup>2</sup><br>950 lb<br>1700 lb |
| Performance with 150-hp. <b>Special Performance Wings</b>                           | Climb<br>Cruise  | 1000 fpm<br>158 mph                              | Specifications<br><b>Special Performance Wing</b> | Wing Span/Area<br>Gross Weight                                     | 23.7 ft/125 ft <sup>2</sup><br>1700 lb                                      |

**PROVEN DESIGN**

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

**STALL/SPIN SAFETY**

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

**EXCELLENT UTILITY.**

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

**UNCOMPLICATED CONSTRUCTION**

The basic structure requires few special tools and can be built in a single 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 N. Truslow, Box 424, Fullerton, Ca 92632 (714) 870-7551  
VariViggen spruce kit, plywood kit, hardware, aluminum and fiberglass. Catalog cost \$3

**KEN BROCK MFG.**, 11852 Western Ave., Stanton, Ca 90680 (714) 898-4366  
VariViggen prefabricated components: all machined parts. Catalog costs \$2

**THE AIRPLANE FACTORY**, 7111-A Brandevista Ave., Dayton, Ohio 45424  
VariViggen plexiglass canopy. (513) 845 9872

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

**COUGEN 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 & main landing gear, 1-1/4" sq. steel tube.

**JESSE WRIGHT** (VariViggen builder)  
7221 S. Colorado Ct. Littleton, CO 80122 (303) 771-5140  
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" x 10" 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, and flight reports as possible. Details mandatory, desirable, and optional changes to plans and to owners manual. A newsletter subscription and back issues starting with CP19 are mandatory for those with VariViggen's 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 ea.

**VARIVIGGEN PLANS - SECOND EDITION.** This is an updated, revised set of very complete drawings and construction manual consisting of a bound 11" x 17" book, containing many photographs, hints and instructions based on actual builders experience over the past several years. It covers the entire airplane, including the engine installation, fuel system, and not only covers the original standard wing in both aluminum and foam and fiberglass composite, but it also includes the composite S.P. Wing, ailerons, and rudders. The manual identifies sources for all required materials and all available prefabricated parts and components. Price - \$165.00 first class mail, \$177.00 Airmail overseas.

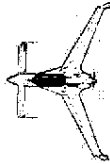
**VARIVIGGEN R/C MODEL PLANS** - Complete construction plans for the 18" - size radio-controlled model airplane built and flown to evaluate VariViggen spin characteristics. Designed for 4-channel proportional radio equipment and engine in the .35 to .65-cu inch size. .555-su inch wing area.

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, .19to .45 -cu inch engines). Price - \$4.75 first class mail, \$5.50 air mail overseas.

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BUILDING 13, MOJAVE AIRPORT  
MOJAVE, CALIFORNIA 93501  
TELEPHONE (805) 824-2645

# VariEze

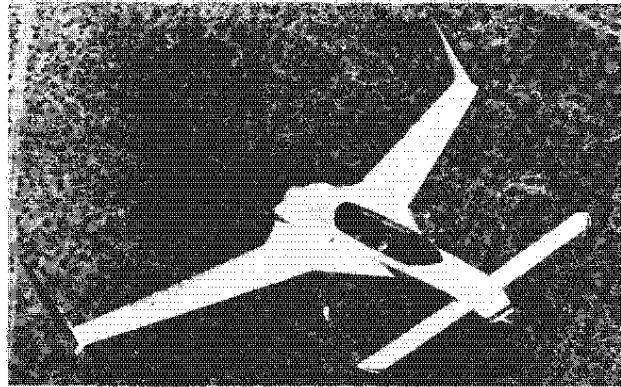


TODAY'S HOMEBUILT WITH TOMORROW'S TECHNOLOGY

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

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

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



VARIEZE DOCUMENTATION is available in six sections.

**SECTION I - MANUFACTURING MANUAL** - This is the complete education manual for composite materials and methods, also, the complete plans and construction manual for the entire VariEze except engine installation. The manual consists of a 153-page, bound, 11"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, Q-200**  
**SECTION IIC - LYCOMING 0235 - No accessories.**

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

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

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

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

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

|              |          |                            |                           |
|--------------|----------|----------------------------|---------------------------|
| Take Off     | 900 ft   | Range @ Max Cruise         | 700 mi                    |
| Climb        | 1600 fpm | Range @ Econ Cruise        | 850 mi                    |
| Max Cruise   | 195 mph  | Min Speed (full aft stick) | 55 mph                    |
| Econ Cruise  | 165 mph  | Landing Distance           | 900 ft                    |
| Empty Weight | 560 lb   | Wing Span/Area             | 22.2'/33.6ft <sup>2</sup> |
| Gross Weight | 1050 lb  | Canard Span/Area           | 12.5'/13ft <sup>2</sup>   |

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

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

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

AIRCRAFT SPRUCE & SPECIALTY CO. or WICKS AIRCRAFT SUPPLY  
201 W. Truslow Ave, Bx 424 410 Pine  
Fullerton, Ca. 92632 (ALL RAW MATERIALS.) Highland, 11. 62249  
(714) 870-7551 (CATALOGS COSTS \$2.) (618) 654-7447

KEN BROCK MANUFACTURING, 11852 Western Ave, Stanton, Ca. 90680  
(714) 890-4366. Prefabricated components - wing attach assembly, nosegear machined parts, control system components, fuel caps, engine mount, rudder pedals. Catalog costs \$2.

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

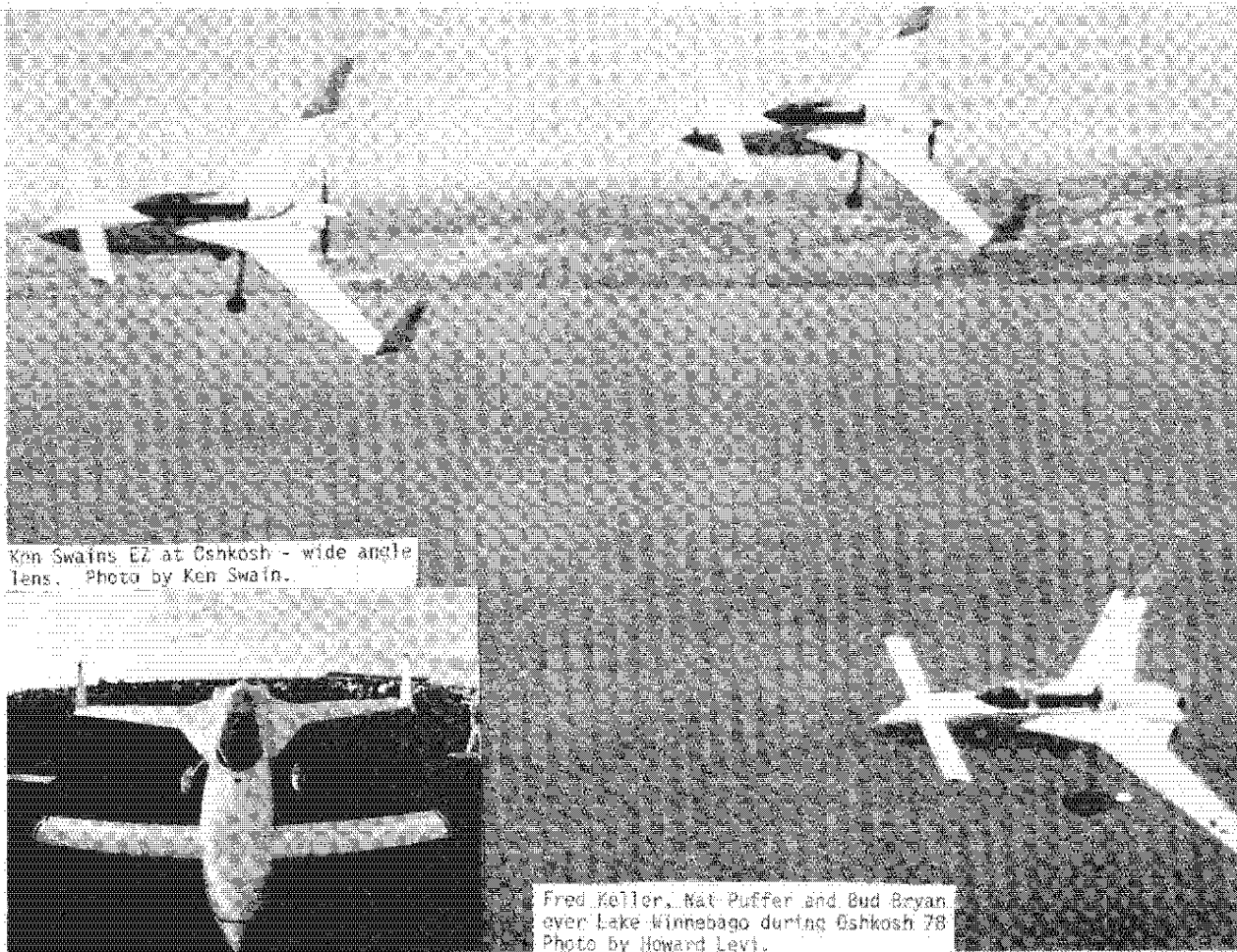
THE AIRPLANE FACTORY, 7111A Brandt Vista, Dayton, Oh 45424 (513) 845-9872 or 233-7754 - Canopy.

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

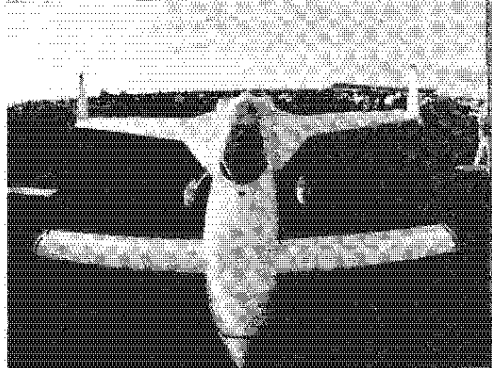
| Check Items Desired   | Price, Including First-class Mail, U.S. And Canada | Air Mail Overseas* |
|---|--|--------------------|
| <input type="checkbox"/> VariEze info kit, includes current issue of "Canard Pusher" newsletter | \$5.00   | \$6.00             |
| <input type="checkbox"/> "Canard Pusher" newsletter, published quarterly. One-year subscription | \$4.75   | \$6.50             |
| <input type="checkbox"/> Section I  | \$139.00   | \$153.00           |
| <input type="checkbox"/> Section IIA  | \$19.00  | \$21.00            |
| <input type="checkbox"/> Section IIC  | \$21.50  | \$23.50            |
| <input type="checkbox"/> Section III  | \$8.00   | \$9.50             |
| <input type="checkbox"/> Section IV   | \$8.00   | \$9.50             |
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| <input type="checkbox"/> Section VI   | \$18.00  | \$11.00            |
| <input type="checkbox"/> 1" Ari-colored jacket patch  | \$1.95   | \$1.95             |
| add \$5 if Calif resident - newsletter is not taxable.  |  |                    |
| *U.S. FUNDS ONLY  |  |                    |
| TOTAL   |  |                    |

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Ken Swain's EZ at Oshkosh - wide angle lens. Photo by Ken Swain.



Fred Keller, Nat Puffer and Bud Bryan over Lake Winnebago during Oshkosh 78. Photo by Howard Levi.

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