**UNBLESSED HINTS FOR THE LONG‑EZ**

**1995 NEW UNBLESSED HINTS**

**With a few more recent add-ons**

**TRY THEM AT YOUR OWN RISK!**

**Library item 1DO3 from:**

**David A. C. Orr 949-248-5725**

***New issues in italics***

I built the attached list mostly while building, with Dave Ronneberg's help, and to that I added the old ideas of Central States and the older ideas of Squadron 1, I have worked in the Chapter by Chapter Library list as well:

**CHAPTER 1: PLANS**

1DO3: Aug 1987, "Unblessed Hints"‑The ideas that haven't made the Canard Pusher, including all Squadron 1 newsletter hints‑, the ideas are placed in plans chapter order. (Used to be $4.50, this document is the newest update "Unblessed Hints".)

**DISCLAIMER:** This set of hints includes ideas out of the Squadron I and Central States newsletters and ideas suggested to the author as he moved through his own project. Some of them are plain wrong, but not yet discredited. The author finished his aircraft in February 1988 and let the function lapse. Long EZ aircraft are getting so common that no ideas are really new ones, and the inventions we think we have made have probably been tried before. In 1994, he reviewed the ideas, paring and expounding, based on the 6 years and 1000 hours of flying since. Squadron I, II, the authors of the newsletter and this index assume no responsibility for the content. After all, you are the builder. The FAA and therefore the flying public require you to be responsible for your product.

**Stet Elliot** has very ably produced a notebook with all plans changes for the Long EZ. Directories of suppliers and the Author has a long bibliography which you can treat as a lending library.

(where numbered the newsletters are referred to as #9/6 which means issue number 9 on page 6. If not numbered, the date is used i.e. Mar 25, 82/2 is page 2 of March 25, 1982 and the latest will be AS83/2 which means August/September 1983 page 2.) CS = CENTRAL STATES NEWSLETTER IV# = IVHC Newsletter and edition. Many items stand alone in my Library. The source is contained in the code itself, for example 23LP37: means Chapter 23 (engine installation)/ Light Plane Maintenance/37th article.

**WHAT "SPECIAL" TOOLS DO YOU NEED**

Build a good flat table, bondo it to the floor if possible.

1) Get an epoxy pump. See Paul Prout on ratios, Library item 3SI1 "How Ratio Pump Works".

2) Use an Olfa roller knife for cutting cloth on a soft, smooth piece (minimum 4' by 4') of congolium type linolium‑not your kitchen floor, it gets cut up.

3) A japanese draw saw (designed for plywood) is great for all kinds of foam cutting. (buy from a specialty tool store)

4) A dremel set, preferably with ball bearings to last; get drum sander, disk sander, don't get blue 1" saws, they fly off the machine. An economic replacement is a unit by Black & Decker which has a two year warranty which warranty needs to be pursued. On a typical EZ project you get 3 tools under warranty, and dremmels last only 9 mos to a year with all the grinding you do, without much warranty protection.

5) On a epoxy storage box, see JJ85/5.

**RAF: Some history since they stopped selling plans.**

Burt Rutan put $90,000 of his own assets(from RAF) away for the continuation of the newsletter and RAF telephone advice. As of May 1987, they have found the operating funds have been replaced by newsletter fees and return ("kickbacks") from the suppliers. Mike Melville is dedicated to the newsletters and has been in charge of them since CP18. He sometimes does the work at home. Of Interest, both Mike and Burt were in a 5 year contract with Beech, the incentive to continue selling plans and supporting innovative homebuilts does not match the legal risks for doing so. For more on this topic, read the author's article on Insurance and Liability see DJ86/11-13. Since out of Beech, Burt still seems to be staying away from homebuilt liability, as much as possible.

Mike Melvile and Dick Kreidel have been evaluating lightening capability based on one "event". The "event" is the subject of a videotape available in the library (27VID-P. Squadron 1 meeting On Kreidel's Lightening Strike, Hexel, and Sigtronics). We have since seen another winglet hit by lightening on the ground with little damage. According to Andy Plummer, the most expert of lightening experts, plastic airplanes disintegrate when struck by lightening. According to a former military man who set about to get hit by lightening in an F106 for the Air Force, it is very difficult to get hit by lightening. In any case, Burt Rutan is of the opinion that the insulating properties of fiberglass airplanes is protection for the pilot. The others believe Kreidel was lucky he had an icebound aircraft when struck as it carried off the charge. They believe it was not lightening but simply a discharge of electricity. St Elmo's fire is fairly common on ice bound aircraft.

Mike Melville continues to warn against stupid antics. While the EZ is stall proof in most situations, it is still vulnerable to a high sink rate. Likewise Aerobatics is a problem because the aircraft builds up speed quickly and the airframe red line is hit quite quickly.

Mike Melville says it is important to know there are two definitions for Manuevering Speed (120K in a Long). The common one is the speed at which full control imputs may be applied and not cause structural failure. The other is the speed at which a plane wing will stall before structural failure in a massive updraft (which of course causes a huge change in apparent wind).

**CHAPTER 2: BILL OF MATERIALS**

See also Chapter 30 on selecting projects and 30SA2)

2AP1: Jul 1993, page 65: "Kit-Built Conundrum" on buying from the ads.

2CS1: Oct 1993: "Clark Foam..." no longer offered, try Glastafoam?

2DO5A: Aug 1985: EZ Costs.

2DO6B: December 1994: "SUPPLIERS & SERVICES"-telephone directory for homebuilder.

2DO16: Oct 1983: "Used From Salvage" list by chapter of what can be purchased from salvage yards.

2KP1: Jul 1989, page 28: "Homebuilders' Haven - A fact-packed catalog, big inventory and fast service are features of Aircraft Spruce & Specialty Company".

2MS1: Jul 1985: "Sport Flight, Inc." Catalogue - call 904-796-1874 for latest version, I have a stack of old ones in the library.

2MS2: 1986: Brock's 1986 chapter order price list (xerox charge) & Brock's Catalogue.

2MS3: 1986: Weldtech, Inc. Brochure & Price list.

2MS5: Quality Aircraft Composites, Inc. brochure on Long EZ, Cozy not recommended by RAF.

2MS6: Experimental Aviation price list on Long EZ parts; Ronneberg is pretty tied up with the Berkut, so this may be a little bit difficult to get, at times.

2MS8: Custom Upholstery Services, by Chris Wade, price list.

2MS9: Varga Enterprises, Inc. brochure.

2MS10: West System Brochure & Price List (also available books).

2MS11: Warning on Methyl ethyl Ketone peroxide in some catalysts causes blindness.

2MS12: 1988, ALPHA Plastics Brochures.

2MS13: 1987 Catalogue: All Aircraft Parts 818-894-9115 Outside California, 1-800-351-1213.

2MS14: 1986?: Various Hexel and APCO papers on Epoxy handling.

2MS15: Aug 1989: Feather Lite inc. brochure.

2MS16: 1979: Hastings Plastic Company brochure on 2 part foam.

2MS17: Oct 1986: Hardman Brochure on "Double Bubble Job Size package" for tool bag epoxy kit.

2SA1: Sep 1991, page 29: "Keeping Your Building Costs Down".

2SA2: Jul 1990, page 32: "Setting Up Shop", equipment, bench, etc.

2SA3, Apr 1993, page 69; "Is That Project Right for You?

In Texas there was a new supplier: Experimental Development and Supply Inc., Missouri City 713‑499‑1493.

You should consider buying a stalled project. The fuselage can be inspected by experienced builders in under an hour and will put you months ahead. The author runs a canard finder service for 3%.

For article on buying and selling homebuilt aircraft, see library items Used A/C 3AC1

*Warning:* Some of us have had problems with a blue tinted 1" round dremel saw. The thing catches in glass and dismounts. The steel colored 1" saw doesn't seem to have the same problem.

APCO is now part of Hexel. They sell Norton masks and quality gloves at good prices, see Bob Hummel or call Hexel's Ann Jackson or Phil Cuthbert at 818‑882‑3022 (1982?). For a price list on APCO masks and gloves see library item HEXEL (APCO)(They make your epoxy) On Glass, contact Howard Marinier 213‑921‑4757, 714‑522‑7271. Their discussion is on videotape 27VID-P.

#5/3 Several builders' total building costs are described.

#11/4 An old fridge with light bulb is a good hot box for your epoxy pump.

#7/5 A mono‑kote Heat Gun can be purchased at hobby shops for warming up large layups.

#5/2 Buy piloted spotfacer instead of 5/8" Counterbore. Ron Schoeder and Verne Simon have examples.

Mar 25,82/2 Use cortaid if you do develop an allergic reaction to epoxy.

Use X‑40 two part foam or Hastings 2 lb. two part foam around canopy instead of micro.

Herb Sanders long ago sold his business‑SPORTS FLIGHT to a pair of experienced builders in Florida, they then split and there has been somewhat spotty delivery. The new number for a worthwhile catalogue was 904‑796‑1874. It includes radios, headsets, instruments, special exhausts, cowls, nacas, strake leading edges and aircraft covers. The latter four were particularly useful, but there are other sources, notably Featherlite.

Use latex gloves and cotton under the gloves for best epoxy restistance.

Author has a "used from salvage" list with new prices for comparison and easy reference if you are shopping the salvage aircraft market. (Library Used from Salvage by David Orr, 0ct 1983. 2DO16)

AM84/4a On alternate supplier problem with Burlington, see letters between Rutan and Burlington.

When it comes to the instrument panel and for that matter any of a number of manufactured items for your airplane, give VariEZE owners Dusty and Brenda Rhodes at Vista Aviation (Whiteman Airport‑818‑896‑6442) a try. They are very knowledgeable, fast, and generally cheaper than Spruce on these things. They also stock used equipment. JJ85/3

Bob Hummel has some aircraft, wing and canard stands for the easy movement of fuselage and other parts around a crowded shop and to store things not in use. See DJ86/6.

Aviation Underwriting Agency, Inc. POBox 19267, Greensboro, NC 27419 919‑668‑7751 sells insurance for in progress aircraft. Their rates start at $200 for $5000 coverage ($400 for $15000 etc). See JJ86/10 for application.

**CHAPTER 3: EDUCATION**

The Marital Dangers of Building:

3KP3: Jun 1990, page 61: "The Cost of Flying - An Ultralight pilot lists first-year expense and concludes flying's not as inexpensive as he thought".

3KP4: Jun? 1990, page 46: "An Affair of the Heart - Wherein a beleaguered homebuilder's spouse acknowledges her mate's other love".

3KP7: Mar 1989, page 38: "Wedding Vows - Here are some tips on combining homebuilding and marriage...successfully."

**The People:**

3AP2: Aug 1988, page 77: "Burt Rutan-Different by design".

3A&S1: Aug/Sep 1991, page 96: "Why We Fly".

3CP53/2 Oct 1987, page 2: Special copy of Canard Pusher page on Round the World flight.

3CS1: Jan 1992, CS25/4: "A Racing Fool" autobio. Tom Coughlin.

3CS3: Apr 1993, CS30/16; "World Record Flight" (Dave Timms 30,407' record).

3CS4: Apr 1993, CS30/4; "Long EZ - Vukos Style, Part 2.

\*3CS10: Apr 1994, CS34/24: "EZ/XP - A Long-EZ the Miller Way".

3DO3: N Numbers in Various Places, Feb 9, 1990.

3EA1: 1992?, "Young Eagles Flight Kit".

3MS2: "Custom-built Aircraft" handout on homebuilt aircraft and their owners for airshows.

3MS4: EAA Membership Application.

3MS5: March 26, 1990, The Outlook: "Aircraft pioneers know rewards come from taking risks." On liability, risk and homebuilts.

3MS6: Oct 27, 1989, LA TIMES: "Swift, Odd Aircraft Keeps Dreams Aloft in Santa Monica".

3MS7: Apr 1989, Picayune Times: "Unique aircraft make Picayune stop".

3MS8: Dec 11, 1991, page 1, Wall Street Journal "Upward Mobility -Liability Costs Drive Small-Plane Business Back Into Pilots' Barns."

3MS13: Image Magazine, Apr 20, 1986, page 22: "Plane Folks", on SF airplane builders.

3MS14: Los Angeles Times, 1987?, page 1: "Kit Planes: Amateur Pilots' Dream Ships".

3MS15: 1988?, page 122: "Books - A celebration of design: Voyager, ...of "The Complete Guide to Rutan Aircraft" by Don & Julia Downie.

3PF1: Dec 1991, page A29: "E-Z Greider", on Bob Greider's Long EZ.

3PF2: Jan 1993, page A12: "Altitude Record Broken by Long EZ".

3PS1: Aug 1987, page 70: "Wings For Tomorrow" on Rutan Canard of the future.

3SA6: Paul Tackabury, ???,

3SA7: EAA Chapter Directory - specify the state.

3SA8: Apr/May 1987, page 90/88: "A Long Way From Anywhere"

Building in Enewetak Atoll & Conclusion on Pat Colin in New Guinea.

3SA9: Jun 1987, page 51" "Sun 60" race and winner Klaus Savier.

3SA10: Sep 1978, page 12: "Varieze Two Six Juliet Wiskey" on difficult first flight of Jim Wright's varieze.

3SA13: Jan 1985, page 28: "Brazil...The Eze Way".

3SA15: ?, page 35: "Neil Hunter's Big-EZ".

3SA16: ?, page 23: "A Conversation with Burt Rutan".

3ST1: Squadron II, EAA Chapter 11, Santa Monica Club members.

3VID-B Eye on LA expose on Canards.

3VID-M: Wendover Fly In 1986, and E‑Racer.

**The Long EZ:**

3AC1: Jan 1985, page 5: "Used Aircraft Guide, Rutan VariEze and Long-EZ".

3AC2: Mar 1985, page 18: "Safety Record of the Rutan Canards".

3AP1: ? 1987, page 69: "Easy Street, The VariEze/Long-EZ alternative".

3CP1: CP25, page 14:"Long-EZ Fast-Efficient-High-Utility-Long Range".

3CP2: CP39, page 13: Rutan Price list.

23CS26: CS32/9: "High Time Airframe Maintenance" a very short list of fixes on Melvile's 2000 hour aircraft.

3DO1: 1988?: "The Flying Is Great - Building an Aircraft - Why Not? (reasons people fail) by David Orr.

3DO4: May 1986: "Squadron 1 Newsletter Index", by David Orr.

3KP2: Oct 1989, page 14: "How Long-EZs Have Held Up".

3NG1: Jan 1981, page 76: "They're Redesigning The Airplane".

3SA1: Feb 1980, page 28: "Czechmate" -Dick Rutan's 4800 mile record.

3SA3: Oct 1991, page 16: "Bob & Ginny Greider's Grand Champion Long-EZ".

3SA5: Oct 1990, page 12: "Nopper/Eckes Grand Champion Long EZ".

3SP1: Wint 1986, page 21: "Walter Haines' LONG-EZ".

**The Materials:**

3CS2: Apr 1993, CS30/31; "Bag It" (vacuum bagging).

3CS5: Apr 1993, CS30/1; "SAFETY-POXY Safety Bulletin", on OSHA ruling of carcinogin.

9CS3: Jan 1993, CS29/7: "Lighter Than Air Core Material" - comment on new "SEAgel" = Safe Emulsion Agar Gel.

22CS8: Oct 1993, CS32/6: "Epolite 2427, Hexcel's new MDA Free Epoxy" on straight across exchange of hardner for Saf T Poxy.

23CS16: Apr 1993, CS30/29; "Solvent Gloves Stop Epoxy Reaction", Larry Sligar.

30CS2: Oct 1993, CS32/15-16: "MDA & HOMEBUILDERS - discussion on OSHA ban.

3KP5: May 1989, page 16: "More Composite Basics - Part 2 concludes lessons learned at an Oshkosh forum last summer".

3KP8: Jan 1989: "Composite Cautions - Plastics have revolutionized homebuilt aircraft, but there is danger in the fumes, dust and liquids".

3KP9: May 1988, page 50: "Defeating the Devil's Spanner - Keeping aircraft screws and bolts in place is worth considerable effort and expense.

3LP1: Apr 1988, page 14: "Understanding Aircraft Hardware".

3MS1: Feb '1980: "Touch up Aluminum Parts with Alodine 1200 Protective Coat".

3MS3: 1988?, page 7: "Building Stronger, Lighter Laminates With Vacuum Bagging Technology", by Gougeon.

3MS9: ?: "Composite Basics - Sinking Your Teeth Into Sandwich Structures In Layman's Language.

3MS11: Mar 1982: Brochure on Safe-t-poxy, other Hexel brochures.

3PS2: Feb 1992: "Fiberglass: Cancer threat?" (Sq1:A/M/J'92/10)

3SA2: Date?, Page?: "Helpful Hints for Handling Fiberglass Cloth".

3SA4: Jun 1985, "Are You Using Aircraft Hardware Correctly?".

25VID-C: Rutan's Birthday Flyin Lectures on construction and finishing.

27VID-P. On Lightening, Hexel, and Sigtronics.

**Special Tools:**

3CS9: Apr 1994, CS34/17: "Foam Core Cutting with Inconel Wire and Pour foam, by Jim White.

21CS6: Oct 1992, CS28/24: "Rat Trap Sanding Block".

3MS10: 1985?: "Sticky-Stuff Dispenser - Operating Instructions" by Michael Engineering Company.

3SA12: Sep 1984, page 22: "Making Molds For Laminating/Forming Quality Aircraft Parts".

3SI1: ?: "Epoxy Mixture Ratio" way of checking dispenser proportions or changing them to new mixtures, by Paul Prout.

3SA14: Apr 1992, page 80: (was:3SI2: J/F/M'92, page 9): "FLUKE Electronic Hints - Epoxy Closet Temperature Control"

**Theory:**

3CS6: Oct 1993, CS32/8 & 19: "Long-EZ, SPEED, SPEED, and More SPEED"; on building speed in; and "Winning CAFE Racer Hints" about Hertzler's mods.

3CS7: Oct 1993, CS32/14-15: "Hardshelling" on slurry/dry/then glass??

3CS8: Jul 1992, CS?/2: Pictures of Hertzler's smooth cowl.

3KP1: Jul 1991: Wind Tunnel,"Searching for parasites-as we design and build to reduce drag".

3KP6: Dec 1991: Wind Tunnel, "Does the shape of a wing's trailing edge make a difference in performance?"

3KP10: Nov 1992: Wind Tunnel, "Let's Check out Frontal area and its effect on drag".

3MS12: Sep 12, 1988: "Wings of Fire" (Plastics and lightning).

3SA11: Jul 1985, page 31: "John Roncz - The Aristotle of Airfoils".

3SA17: Sep 1992, page 72: "Drag Reduction Possibilities".

The best education you can get is from other builders. In addition to EAA Chapters, there are clubs in Ohio, the Central States, Washington, San Diego, Sacramento, Santa Monica, Pomona, Washington and Europe.

JOHN STEICHEN, 960 86th St. Downers Grove, IL 60516, 708-985-6671 Is running the DEFIANT CLUB NEWSLETTER Carefully read the safety tips in your Aircraft Spruce catalogue.

Both Sq 1 and Sq 2 have the Rutan video on composite construction, the inspirational one showing the VEZ in flight and the before flight checkout video. Squadron 2 has a Prop installation lecture, Magneto lecture and paint supply lectures, one on cowl installation, antennas, and the Ellison throttle body on videotape as well. I have copies in the Library.

We now have the videotape of the good lecture by Hexel, APCO, Dick Kreidel on lightening/icing experience he had, and part of a sigtronics presentation.

Hexel suggests that for the best stippling that you cut down your brushes until short stiff bristles are left.

Debbie Iwatate had a book on her Long EZ modifications, write: 400 South 41st Ave., Richland WA 99352 ($20.00), she sold her Long EZ about 3 years ago.

Florida Feb86/4: A good book on instrument installation is Firewall Forward., by Tony Bingelis of EAA, many of his articles are lifted from the last 10 years for my library.

We highly recommend joining the National EAA for their magazines.

Hinges: CS: See Nutting's Hinge Alignment article, Library Item 18SA1.

AS83/2 Bob Brown suggests bead blasting aluminum parts instead of sanding them to the finish required.

On specs to protect aluminum with alodine 1200, see Library item #25.

#5/2 A good purchase is the Airframe & Power Plant Mechanics Guide Handbook, EA‑AC65‑9A, EA‑AC43.13‑1A & 2A published by U.S. D.O.T.

#11/2 A good antenna book is "TTE ARRL Antenna Book" by American Radio League ($5.00?).

May83/8 See the good article on Finishing, which involves planning and care from the beginning on (Library: Kreidel articles on FINISHING DJ84/4 25SI1).

May83/24: Good article on handling fiberglass cloth. (Library: Helpful Hints for Handling FIBERGLASS Cloth 3SA2)

For an article on Composite Basics from Homebuilt Aircraft Mag, See library:3MS9.

**CHAPTER 7: FUSELAGE EXTERIOR**

**NACA SCOOPS:**

7FA1: Nov 1948: NACA Research Memo: "Ram-Recovery Characteristics of Naca Submerged inlets at High Subsonic Speeds"

7IA1: 1985?, Adjustable NACA Air Scoop by Ian Ayton.

7SA1: Dec 1991, page 72: "NACA Inlet".

**Other:**

7SI1: J/F/M 1991, page 20: "Bob Hummel--Fuselage, Wing & Canard Fixtures".

**Plans 7‑1:** May83/8 Read the Sport Aviation article on Finishing again. Library: 25SA2: "Finishing Composite Aircraft".

**Plans 7‑1 step 1:** One builder suggests leaving the circle for the elevator tube uncut (drawing just above plans page number 7‑1) until mounting canard and elevator.

**Plans 7‑2 : step 2.** If you plan to have a marker beacon antenna, this would be a good step to install it, the two poles are 34.3" long, each pole (see Chapter 22 notes for more info).

**Plans 7‑2 step 2:** One builder also left the fuselage covering until his nose was on; the foam gets "dinged" more, but this does solve a certain "coke bottle effect" in the F22 area which later needs filling. The shaping you do around F22 is designed to shape into the cute little stock Rutan nose. If you plan a longer nose, you may want to forget about shaping the fuselage there too.

**Plans 7‑2 step 2**: One builder suggests you lay out the landing brake before slurrying, cover the exact area in duct tape and not waste time wetting the area out. It makes it easier to remove the area when doing the landing brake.Plans 7‑2 AS83/2 Jump ahead to chapter 21 and cut out the strake cut outs early to make running of controls, electrics and canopy latches easier. Why not cut it out a little shy so you can sand down to match strake surface when strakes are installed.

**CHAPTER 8: ROLL OVER/SEAT BELTS**

**Plans 8‑1:** AM85/12:One Flight Standards official of the FAA has stated that with three rollover accidents in which the roll over structure did not fare well, that Rutan should and would be re‑evaluating the structural integrity of the roll over structure. Rutan has responded that it is impossible to give any such protection (short of landing gear on both top and bottom).

**Plans 8‑1:** AS85/5 John Bauer's three pages of ideas on how to strengthen the head rest while in construction (no retro described) are available.

**Plans 8‑2 step 2:** Several builders‑taller ones‑suggest moving the harness attach points closer together and higher. In the case of the front seat, up the head rest sides.Plans 8‑2 step 3: one builder suggests that leaving the roll over structure until the middle of canopy chapter which will make fuselage much easier to work on inverted on tables and safer when moving the canopy around.

**Plans 8‑2 step 3:** Three EZ flyers point out that the canopy gas spring many are using should be set up to exert down pressure when the canopy is down. Added benefit: the canopy, even if unlocked, has stayed down with the gas spring for one of their aircraft in the pattern while manuevering back to a landing.

**Plans 8‑2 step 5:** Shoulder harness should be stored (if already purchased) until after zoletone paint in chapter 26.

**Plans 8‑3 step 6:** For $67.50, Weldtech (509)967‑5660 has a retractable entry step kit, but it's heavy. (see library item 9B), FM87/17.

**Plans 8‑3 step 6:** Clayton Kau suggests a simple hole through the step will provide purchase to rig a nose tie‑down. ON85/10

**Plans 8‑3 step 6:** If you didn't get to it before glassing the outside of your aircraft, you may consider the idea of a Florida builder who uses a 1" high pre‑drilled block as a guide to placing the anchor bolts. AS85/3?

**CHAPTER 9: MAIN GEAR/LANDING BRAKE**

Air Brake Spring.... I spent a lot of time burying the air brake spring to avoid biting little fingers in the back seat. Two weeks later someone showed me a piece of simple thin vinyl (shrink?) tube over the springs-what a good idea.

Air Brake.... I wonder if you really need one. I have flown ignoring the air brake for about 3 years now. I only really use it over the trees at Santa Paula. Most guys at Santa Monica use it to help deflect rocks from the front wheel. The burble caused by cutting off straight air to the idling engine on final always seems a little disconcerting. Maybe my technique is too lazy. The "both rudders out" air brake technique is a little easier to use, if you remember to let the pedals up before you touch locked wheels down.

*For electric speed brake motors: Ken Miller’s advice 9/09:* [*http://www.firgelliauto.com/show\_info.php?page\_id=35*](http://www.firgelliauto.com/show_info.php?page_id=35) *Order the length you want, it will either be a 6" or 4" you measure.  Get the 150lb with potentiometer feedback, and that will drive a Ray Allen indicator so you can tell the position in the cockpit.* [*<kenezmiller@optonline.net>*](mailto:kenezmiller@optonline.net)

*Jorgenson’s advice 9/09:*

*Here's the link to the actuator I bought:*

[*http://dcactuators.com/Detail.asp?Product\_ID=301.200\_6104T*](http://dcactuators.com/Detail.asp?Product_ID=301.200_6104T)

*It has a 110 lb max dynamic load, 500 lb static, built-in limit switches, 4" stroke. It comes in at around 900 grams which is about 100 grams more than the mechanical system it replaces on the Varieze - a system which tended to hang up when deployed, had no intermediate position, and interfered with the throttle quadrant, so an electric motor makes perfect sense to me. The mounting holes are 1/4 inch which is overkill, so I've bushed them down to 3/16". The installation is almost done, and looks clean and simple. The motor has a two wire lead, so a simple reversing polarity switch is all it needs.*

*The price including tax and shipping was $170.65.*

**Plans 9:** You really don't need the tires until the end of the project. For that matter, you can leave the wheels and brakes until the end too. You will find you will be doing the bottom finishing (hopefully with the winglets off still, and then would be a good time to rig the wheels and brakes. How old will the tires be of first takeoff if you do it earlier? But put in the brake line conduits, as outlined below.

**Plans 9:** The new Cleveland brakes from the Caproni Jet Trainer is available through Varga Enterprises, 2350 S. Airport St., Chandler, AZ., 85249, 602‑963‑6936. The parts you need are Heavy Duty disk #164‑85 and Caliper #30‑133, but because of the marvels of package deals, when you buy them with two heavy duty 5 x 5 wheels, they are cheaper through Varga., DJ87/3. Mike Melville highly recommends them for all but the old Varieze. While the metalic pads were better than the old pads, these new brakes supersede even the metalic pads. The author has had 3 years of trouble free use, pads last about 175 hours.

**Plans 9:** Chrome disks are definitely out. They cause a surge during braking that could endanger your gear legs. The guess is that the surge is caused by chrome hard spots over a steel weld. Nobody seems to have tried the Stainless steel brake disks advertised around. Theory says they don't have the same heat qualities. Why bother with all this with the larger brakes mentioned above?

**Plans 9‑1:** One Long‑Ez owner went to Oshkosh in his heavy EZ and hit high altitude runways on a hot afternoon and after coming to a stop on the active, was unable to taxi due to wheel lock. Other owners who had experienced this difficulty found that as their pads got thinner that the wheel cylinder pistons were cocking off to one side. (One even spun around the axle!) Our Oshkosh owner found that Cleveland, and therefore Aircraft Spruce, sends some master cylinders vented (a small hole in the plastic cap on the Master reservoir) and others not. He vented his only after having a minor melting of the main gear due to the brake drag. The melting resulted in a landing shudder due to toe out of the main wheels.

**Plans 9‑1:** another idea is the Goodyear 9532101 Wheel and 9532302 Brake sold by C.W.Lasher, 4660 Parker Court, Oviedo FL 32765. He sells them for our axles for $450. He claims the geared and floating disk transfers less heat to the wheels and therefore to the gear legs. Again, why not the Varga supplied heavy duty brakes?

The Big Brakes.... Purchased from Varga Enterprises of Chandler AZ, these things are worth having. Less brake work, better stopping power, potentially more heat to melt the gear, but a very good idea.

**Squadron 2 Library Items:**

Ken & Debbie Iwatate's Newsletter on forward BRAKE masters, #42B.

Bill Reid's BRAKES, #42E, AS85/9,12.

Bob Davenports Brakes, Nose, Gear Doors, #42H.

Cleveland BRAKE Documents, #42A. How to Stop BRAKE Problems, Private Pilot, 42C.

Reline your own BRAKES, Priv.Pilot 1980, #42D, AS85/11.

Cleveland BRAKE Inspect. and Reline, Light Pl. Main, #42F.

Appalacian STAINLESS STEEL Brake brochure, #42G.

Dresser Tire & Rubber Co Catalogue‑lower prices, #42I.

Cleveland Brake PREFLIGHT Inspection Light Plane Maint Jan87, #42J.

How to Check Wheel CAMBER & TOE‑IN Light Plane Maint. Mar87, #42K.

Control System CABLE Terminals and Connectors, #54C.

Are You Using HARDWARE Correctly: Sport Plane jun85, #54I.

**Plans 9:** Glazing brakes: Per Wicks, for metallic brake pads, do 2 consecutive full stop brakings from 30 to 35 kts, without allowing the brakes to cool between applications. If the brakes seem smooth they are glazed. If rough, do it again. On organic material the procedure is to cure resins. So do 6 or more light pedal effor brakings from 25 to 40 mph. cool between stops. Overheating causes organics to carburize.

**Plans 9:** In addition to the above library ideas on moving the brakes up front, Vern Simon of SQ 2 has the newest design which involves leaving the brake masters in "anchored" in a slot device (to allow rudder first) running forward in the nose and pinned directly behind the rudder pedals. This design requires a remote master reservoir, but is very good.

**Plans 9‑2:** One builder suggests you leave gear off until necessary to save space and make the fuselage lighter and more maneuverable for bottom and nose work (i.e. nose and landing brake, landing light).

**Plans 9‑2:** Dave Ronneberg suggests that the 1/4" jigging blocks should remain perpendicular to the aluminum tubes, even if that does not make them parallel to the surface of the main gear‑later drilling of the tabs is improved by having a perpendicular surface.

**Plans 9‑2:** Aircraft Spruce is not the approved source of axles. One builder finds that the radii are too large‑resulting in the brake disk standing off the axle more. The Brock axles are in need of modification by adding a spacer between gear and axle, or by adding longer rods where the two sliding rods are located. It has been suggested that Brock may manufacture the spacer shortly. In other such spacers, some have fashioned them out of Phenolic block.

**Plans 9‑2:** The plans method of setting the toe in is actually done with no weight on the gear. When you unload gear, it actually rotates toe in or out. If you could calculate how far the gear is going to be splayed on normal takeoff and landing, you could then spread the axles that much and then line up the toe in. How about loading your aircraft to 850 lbs and placing a spreader between the legs and then turn the aircraft over? One of the Hole‑In‑The‑Wall tried it and it worked. We then realized that when you watch a loaded Long‑EZ the gear tips are nearly perpendicular to the runway. Our later, and successful attempts simulated this loading and spreading by placing a sizzors jack with a 2 x 4 (and clamped to a longer guide 2 x 4 to keep the thing from shooting off through the next wall. We then glued a straight box extrusion accross the tips of the gear legs as a reference straight line and glued the axles to two 6" pieces of extrusion which are in turn floxed in place and aligned with the reference extrusion. If done right, the axles have to be on a perfect parallel line in 3 dimensions.

**Plans 9‑2:** A builder suggests that the proper toe in can be baked back into the gear with a hot hair dryer, but be careful. If your gear gets heat affected by hot braking, you may be able to straighten it up with the same procedure. To avoid heat problems, fiberfrax between gear and axle back also. Get the big brakes.

**Plans 9‑2:** If you use standard tires and don't go to the Lamb 4" tires, you actually raise the rear of the A/C. RAF has suggested cutting off 1 1/2 inches of gear if enough remains of the vertical section for proper wheel mounting, to help with attack angle on takeoff. A 1 1/2" lowering caluculates out to 1 degree pitch change and a little weight savings. Actually, full fuel changes the angle of attack more.

**Plans 9‑2:** The Wicks Flyer shows new Lamb tires‑6‑Ply for $25. each, 8 ply for 29.25 each and tubes for 6.50 each. Of interest, Dressler Tire in Los Angeles carries Chinn Schinn (SP?) which manufactures Lamb's 4 x 5s at a better price. Sq 2 orders them in bulk from time to time for just over $24 for tire and tube. Dressler asked jokingly how many ply ratings we wanted to print on them. As aircraft tires are not road rated, tested or regulated by the Fed., the ply rating is just whimsy.

**Plans 9‑3:** Melville suggests DOT 5 silicon based brake fluid. If you are using anything less now, you are getting more corrosion, chance fire, and just don't have the best. To clean out the old stuff, use denatured alcohol. Silicon fluid does pick up air. Instead of trying to bleed the brakes as you might in a car, Melville suggests you get a clean oil pump can, connect one end of a short clear tube to its nozzle, the other to the Brake bleed nipple listed in Spruce catalogue. You then pump the fluid up from the brakes to the master reservoir, which lets gravity help you keep air out of the system. Be sure the lines go to the top side of the slave cylinders, the bleed should be at the bottom. Be gentle with the bleed nipple, don't torque them down.

**Plans 9‑3:** There is a plan for a simple parking brake in the CC/spring87/7. I don't know what "a parking brake lever on the master cylinder" is, but the author connects a nylon rope through a tube to the cockpit.

**Plans 9‑3:** To avoid overheating brake lines, RAF suggested fiberfraxing and aluminum tape over the brakelines within the last six inches or so to the wheel cylinders. Now Melville suggests you use Stratoflex lines the whole way, or at least the first six inches‑they are custom made by Deering at Long Beach Airport among others.

**Plans 9‑3:**

Ian Ayton mentions that (if you put brakes on firewall) even with room for them, the brake arms do not always fully rise up. The result is that the valve in the brake master does not relieve pressure and the brake remains on and heating as you taxi home. He is concerned enough to suggest small springs to return the brake arms fully up. CS's Jamison agrees‑CS Ju86/10.

**Plans 9‑3:**

What happens if you have to change brake lines in the Long? Headaches! One builder suggested aluminum outer tubes be installed. They tend to crimp and pinch the lines themselves, besides alum. is heavier than simple plastic tube in McDonald's straw thickness. (Yes even that has been done, courtesy of McDonald's). AS84/4. Put two relief tubes per side and then you will have a place to run a spare brake line at need.

**Plans 9‑3:**

One of our builders reports he went to his gear in cold weather (500‑eat your hearts out Chicago) and found the nylaflo as brittle as uncooked noodles. It broke off in his hands. He reported the thing to Aircraft Spruce and sent them a sample. A month later the remaining piece of tube still in the project was back to its resilient self. First blush reasoning was that a solvent rag attacked the stuff. But it is supposed to be impervious to solvents. Melville suggests sunlight causes failures.

**Plans 9 Seat Belts:**

CS's Jamison tried to put hard points for shoulder harness in head rest by making head rest wider. This just made back seat even harder to see out of. He advocates narowing head rest and putting seat belt hard points closer together but not on head rest. CS Ju86/9.

**Plans 9:**

Phil Mancini, instead of heavy microlayups to add relief tube, brake line and tapered trailing edge to the main gear used a rather complex tool to cut foam into little triangles with guide holes for these lines, see template DJ86/5.Plans 9‑1: Landing Brake: The parts list on the Landing Brake plans is not complete. See the author's LongEZ costs breakdown. You may also want to recess the bolt heads on the outside surface skin by use of different bolts and strengthened recessed holes.

**Plans 9‑1:**

Landing Brake: One builder suggests you simply place a thin large diameter shrink tube over the springs to keep them from pinching clothes, baggage etc. A more exotic way is to rotate the spring attachment about 1100 and stretch the springs by way of a short cable to the instrument panel intead of up the back of the panel. They will then be inaccessible inside the left arm rest.

**Plans 9‑1:**

Landing Brake: Realize that 40 lbs tension on the landing brake is not adjusted by spring strength. Rather, it is simply the location of the forward edge of the hole in the rear floor which serves as a stop for the landing brake rod which is approaching overcenter.

**Plans 9‑1:**

Landing Brake: Before you swedge your speed brake cables, slide on some heat shrink. You wouldn't believe how many times you could puncture your fingers on the wire ends while fiddling with the left arm rest otherwise.

**Plans 9‑1 :**

Landing Brake: One builder suggests you get an even .5 or .6 depth in the landing brake cavity by carving flat furroughs by router, then sanding out the ridges between. But stay at least 3/4" away from the glass edge as your will be shaping the foam in that area.

**Plans 9‑1:**

Landing Brake: Weldtech offers a replacement for LB12345 ($27.00) call 509‑967‑5660 or library item #9B.

Wheel Pants? see Chapter 24 below.

**CHAPTER 10: CANARD**

**The New Ones**

**Plans 10:**

Dave Ronneberg sells new ones unsurfaced for $2000‑213‑477‑5958. Didier Makowski is competitive‑213‑397‑4110.

**Plans 10:**

The following hints on the new canards: 1. Use the correct contours when you make your hotwire cuts. Cut out "A" template, glue and trim and then double check it to Accurate, full scale drawing on page C‑1. Then cut out others matching them to "A". 2. Cutting foam into 3 smaller blocks, read LPC‑124, CP46, Page 6 first. 3. Before cutting shearwebs, use a dowel to drill holes through cores for re‑alignment after shearweb layup. Try to drill holes the same way on each for ease of reconstruction of leading edge back on pins. 4. Page "A" erd column from left, 2nd para down an960‑10L should read AN960‑416L washers. 5. Be sure leading edge cores are straight from end to end when refitting. 6. Be veryu careful to follow LPC‑123 on 11" dimension, not 10". 7. Spruce had to special order 3/16" stainless rod for $.64 for 12ft‑304 SSrod, 3/16. 8. Page "B" extreme top right col. Pg 2, if you insert NC‑3 into slot in canard exactly to the depth as shown on Accurate, full scale drawing Pg C‑1 or little less, you get only 7‑10 and have to grind something like the top edge of the protruding part of NC‑3 to get full travel. 9. Follow LPC‑122. 10. Brock may supply CS13 instead of NC13 spacers, they are not .200" long and are wrong.. DJ86/4

**Plans 10**

New Canard: FM863 Prior to microing blocks on canard tips, insert hinge pins (elevators off) and slide toward centerline of canard. After blocks are microed on, slide pins against and through these blocks to avoid cutting away too much of this hole as need some body to micro the plastic tube into. (Use plastic tube smaller than plans).

**Plans 10:**

Brock has recalled a bunch of lift tabs on the new canard. If you have any doubt of the history or strength of your tabs, check yours for hardness and talk to Brock. The fix, if already installed is a 1 hour job. AM86/12.

**OLD CANARDS AND GENERAL INFO**

**Plans 10‑1 step 1:**

For nice square straight hot wire cuts, simply drill nail size holes in a pair of 3' squares. Use the flat surface of the table to provide the guide with blocks of foam weighted and flat on the table, near an edge and nail the squares to the ends with an edge on the table.

**Plans 10**

It is thought that the pitch down in rain can be markedly improved by taking 600 grit sand paper and roughing the finish on the leading edge on the axis of flight (not spanwise).

**Plans 10 step 1:**

JJ84/3: Hot wire tool, it is better to use and .042" wire instead of plans size .025" for reducing lag. When cutting, after testing the speed, let cool and then place on the foam before turning up, it tends to be a smoother start that way.

**Plans 10 step 1:** When cutting, as well as weighing things down, glue them to the table with 3M "77" spray glue or 4 min. and don't even move a weight until cutting is done on each piece. Leave bottom piece glued as a jig for gluing parts back together. When gluing blue foam together, don't put micro where you will be cutting through a micro line later.

**Plans 10** You can get blue foam cheaper from direct supplier. The price goes down with each ten billets. You need about 10 for each aircraft, so club together with a few builders and realize they are being sold as construction billets not for aircraft: Cellular Plastics.

**Plans 10‑1**

If you go with the old canard, more than a few have noted that the plans built trough within the first 2 feet of the fuselage is not quite deep enough and their canard goes fat when all the glass is laid up. Sand down a little extra, no more than an eight. After all, it is better to fill the area on the spar back up to contour than try to fill up the top to meet an irregular or high spar. With the skin on, you can't sand the spar down. Melville has recently suggested using 3" UNI instead of flag folding, that would work too.

**Plans 10‑1 step 1:**

There are some templates available for new and old canards. Be sure they conform to plan if you borrow these. There is nothing more important in shape than the canard.

**Plans 10‑1 step 1:**

When using dowls, be sure not to push them through the place where the aluminum hangers are going to be placed during the cap procedures, the simple procedure of dividing each half into 3 puts the silly dowls in the exact wrong place.

**Plans 10‑2 step 2:**

Foam blocks can be joined by X‑40 thinly applied, resulting in easier sanding, but the joints

expand a little. To get more working time, one builder put his instant foam in the fridge before using.

**Plans 10‑2:**

Canard attach bolts must not be loose, drill out and place larger ones at need. If you have to, tear into your canard forward of the sheer web and place new tabs in and redrill. It is better procedure to ream out the hole to size than overdrill.

**Plans 10‑4 step 3:**

#9/3, Jigging foam to do bottom and top skin layups, use 15 or more jib blocks to hold foam true, expecially at the trailing edges. If true, you'll have less filling to do and less hinge fit problems.

**Plans 10‑4 step 3:**

When flag folding the caps, mark the center of the whole UND piece so you can overlay the mark on the same central point fold after fold which will yield a symetric result.

**Plans 10‑5:**

All spar caps will end up flatter if you overlay them when wet with peel ply, then saran wrap, then foam or wood of uniform thickness in 3" wide sections and then weights that will not slip off the boards as the epoxy compresses and slides around. When it is dry, you may have to use a dremel dixk sander, extending out onto the blue foam no more than 1/8" to cut off the flash‑spar glass that standus up on the sides of the trough. One builder even cut spar cap "molds" from wood to place down over the cap so that it was actually curved like the canard contour‑and they say this ain't no work of art.

#6/5 A torque chart for Aircraft bolts.

#8/4 To make a lighter layup, sand down the foam with fine grit sandpaper (#150+).

AM84/2 for small corrections to Sam Kreidel's finishing article.

AM84/2 On Imron paint selections.

DJ85/2 The Squadron I construction photo album is there for entertainment and edification. Contact the Squadron 1's Joe Heapy.

***Builder Hint:***

Whatever you do, don't fold your cloth scraps to store them. Try to store scraps as flat as possible, i.e. put UNI in a large flower box. Sharply folding glass, before wetting it, is functionally the same as sawing through the finished layer.

***Builder Hint:***

A cheap alternative for unwaxed cups is clean yogurt containers.

***Builder Hint:***

One builder uses an instant glue called Zap-a-gap. Apply part A to the surface and spray part B on the other surface and slap them together for instant fit. Great for taping tubes to fuselage side, placing jigs before bondo‑ing them. Get from hobby stores.

***Builder Hint***:

To get a good clean cutting line on BUNDO, and avoid the "frizzies", use a seamstress trick. Pull out some strands at the measured dimension before you cut, then you will have an easy guide (blank space)to cut by.

***Builder Hint***:

For all sanding blocks, use 3M "77" spray glue for quick attachment and easy removal‑do no hand sanding.

#12/3 FAA Inspections differ with each inspector, check with yours early. For Mr. Detwiler, see discussion in #12/3.

JJ83/6: Read a long article on Composite structures, how cloth is made and bonds etc.

For protection of aluminum parts, see library item #62.

***Builder Hint***s:

Around the engine attach and other stress areas, be sure to have bolts in precision holes. Drill 1/64th small, use a reamer to bring out to the exact size of your bolts. Just hoping for the best and tightening down the bolts is not good enough. If a hole is just slightly outsized, the NAS close tolerance bolts are slightly larger. Drill steel then aluminum when the two mate.

***Builder Hint***:

To level everything, you may find a water level useful‑see hints in chapter 14.

If you are going to designate a sweat shirt for getting dirty in, you may realize that the epoxy never comes out, is washable and that you may want to go directly to a posh restaurant(McDonald's) in your work clothes. Make a practice of wearing it inside out on the aircraft and when you haven't got it in wet epoxy you can turn it right side out for formal wear. JJ86/7.

Please build light. We heard the other day of a builder who has just tipped the scales at 1000 lbs, dry. He has to now pick between a kitchen sink, fuel, baggage or a passenger, legally. JJ86/7

If your Sticky Stuff dispensor gets gummed up, you can pour the stuff out carefully, or just unjam it until empty, then: Clean the tank. Slosh acetone around with a small paint brush. Keep it away from your styrene foam. Acetone is flammable! The tank will be stained, but when the hardner residue is dissolved away, empty the tank into a coffee can or glass jar to allow it to evaporate safely.

Then remove the tank check valve(and tank) using a 1/2" socket. Don't lose the metal washer between tank and valve, and fiber washer between tank and pump block. Soak valve in acetone until clean. You may find stringy material in between these parts. This is the suction side of the pump. The discharge valve ia a spring and ball located inside brass reducer fitting into which gooseneck discharge tube scres. Brass is soft and the fittings are tight. With pump chamber now open, pour in acetone and use Q‑tips to swab out. Expect more gunk at bottom. All valves are metal to metal and should last a long time. If you ain't got one you are crazy. JJ86/3

**CHAPTER 4: FUSELAGE BULKHEADS**

Short front seat.... One of the most interesting things about my plane is the extra room in the back seat. 8" at the top and 4" at the bottom. The front seat modification required modifying the seat panel, the floor cut outs, the location of the air brake (in about 4 areas), the arm rests, the canopy location, the canopy latch, the thigh support and the upholstery shapes. What a recurring pain! But, I have more room in back and tall men can't easily steal my plane. I am glad I could install an extra set of seat belts and sad to see my boy grow out of the space intended for him. In 8 years he will be ready to learn to fly and I will have to move the seat back for him.

**CHAPTER 5:**

Consider installing the front seat bulkhead at 37 degrees. I think this is from a test done in the 90s where every pilot chose this as the most comfortable angle. Slightly less angle is easier on the front neck muscles. I have an 8 degree wedge for the seatback made of the 1/2 inch console foam and one layer of BID. With a slight trim of the foam on top or bottom before glassing the seat-back could just be installed at that angle in the first place. It is a structural bulkhead so installation would be per plans. If i had done this during construction i would keep the top of the seat at the same place and move the bottom back slightly. Another person might choose the opposite and avoid minor adjustments to the belly board installation. **(This change affects about 8 chapters of the plans all the way to canopy latches.)** [bill@skybeyond.com](mailto:bill@skybeyond.com)

Consider having the canopy leading edge aft of the instrument panel. Then the top of the instrument panel can be structurally joined inside the top fuselage with corner tapes fore and aft. That adds strength and allows an access hatch to the instruments forward of the instrument panel.   
My canard cover is not attached to the canard and is a hollow storage compartment (sectional maps for the coast i am not on-in a baggie), and allows easier canard installation. Walls fore and aft of the canard cover keep things from falling inside or into the elevator tubes. Those two removable access panels plus the nose hatch are held in place by two pins (1/8 inch stainless welding rods) in plastic tubing going forward through the instrument panel and forward inside the top skin, going through the hatches along their top inside skin. All done after the fuselage nose and canopy were built. Most folks are glad they installed a rain drip rail on the lip forward of the front canopy edge. (A note here - often someone will object to having the canard cover detachable because of supposed loss of strength in the structure there. The proper concern is actually when the top area over the instrument panel is made to be removeable. Not what i am talking about. I have actually strengthened this area by tieing in the top of the instrument panel with structural corner tapes fore and aft).  
I have a false floor under the front seat to get the contour i want and save cushion depth and weight.  
I have one inch more leg hole width through the instrument panel. Made all of the side consoles 1/2 inch closer to the fuselage walls. The throttle fit the narrower console, the speedbrake arm fit with a shorter bolt, and the right sidestick and torque tubes also operate properly. Primary change was to remove 1/2 inch off the inside of the plywood mount for the sidestick where it mounts to the right fuselage wall. And make the torque tube hole throught the right seat bulkhead wider. The LongEZ has the fuselage wall glass to glass with the foam removed by the sidestick for more knuckle room - i have plexiglass windows. Of course, confirm acceptable operation before installing.     
These things are minor and will be a drop in the bucket compared to the months of added construction time that will be added by other simple things you will think of     I filled four notebooks of ideas while waiting to build. Not using them litterally saved me a ton.   
A friendly but strong encouragement - find and read "The List" in the EZ Chronicles (EZ.Org) on the home page here. Helped me fly about 8 years sooner.



Best to you- Bill James [bill@skybeyond.com](mailto:bill@skybeyond.com)

Plans 4‑1 #5/2: Read ahead in the plans to anticipate future bonding areas for peel ply.

Plans 4‑2 So many people vary the height of the canopy or its fore/aft position that the beginner should simply build his/her instrument panel about two inches higher above the longerons and cut it to an appropriate height when fitting canopy.

Plans 4‑2 : Add hard point made of plywood in the throttle area of the instrument panel.

Plans 4‑2 May83/25 Sport Aviation article on a good hole saw for the instrument panel. It is better to do your cutting when you have your instruments.

Plans 4‑3 : Of course, check the change in the height of the firewall in the Canard Pusher. It might be useful to leave the dimension even higher until you are ready to fair the canopy section into the top of the engine cowl.

Plans 4‑3 : CS's Jamison, had he to do it over, would widen the firewall 1/2" on each side to give more space outside the engine mount. He realizes that there would be more spacers between longerons and L brackets to hold engine mount. He thinks the tradeoff is worth the problems with the pre‑fab cowls‑the author does not.

Plans 4‑3 : Many builders suggest that the large oval should not be taken out of the center of the firewall. You will want to place the fuel pump on it later. (See DJ85/4)

Plans 4‑3 : AS85/3 Before placing AN509 screws in the firewall, flatten the sides of the head so that the heads won't be tempted to rotate when you are tightening the nut on the other side.

Plans 4‑3 : Don't buy Aluminum and Fiberfrax in plans chapter 4, wait until chapter 15. If you cut it out, don't place holes in fiberfrax and aluminum for longerons. (They go through plywood only) Only the metal extrusions go through the entire firewall.

Plans 4‑3 : Flox is a good hand cleaner for epoxy too.

CHAPTER 5: FUSELAGE SIDES

Plans 5‑1 step 1: There is a useful full scale mylar template available from D. Kreidel for the sides, use it with the understanding that you will check measurements for yourself, after all, you are the builder.

Plans 5‑1 step 1: #5/1, Note that fuel guage does not go to top of foam.

Plans 5‑1 step 1: J‑J/83 AS83/1(updated) Paul Prout's new fuel guage is selling for $99 including postage, low fuel warning and 6 weeks wait right now.

Plans 5‑1 step 1: A simple depression on the tank side of the fuselage, instead of the complex plans depression, can be used if you use Prout's fuel guages. When laying up inside, just lay down some precisely cut grey tape in fuel guage area. When in chapter 7, carve and sand down to tape and remove so that there is no foam where fuel enters new guage.

Plans 5‑2 step 2: For convenience leave longerons long until chapter 15.

Plans 5‑2 step 3: allow full cure on bottom longerons before removing nails etc.

Plans 5‑3 step 3: Most builders feel green urethane is not dureable and are switching completely to blue(wing) foam‑find a builder with scrap from wings. Additional plys can be layed up on paper, tin foil or saran and cut, then placed in final position, squeegeed and then backing removed.

Plans 5‑3 step 3: What LPC 20 is trying to tell you is that the 15 ply BID pads (pg 5‑3, center left) for larger main gear extrusions is 1.125" short of the hole for the centersection spar to allow the engine extrusions to be flush with the cross hatched area over the LWY area on page 5‑3. Study step 13, on page 14‑4, A4 and A5.

Plans 5‑3 step 4: Dimensions on spar gap very important.

Plans 5‑3: Dave Ronneberg suggests the following short cuts when building the fuselage: 1. place the Rudder tubes in place (Plans page 16‑7) then (2) add hard point for Landing brake (LB17) using landing brake plans page A‑1 for placement and (3) hard point for the trim system (Part PT‑1) from plans page 17‑3, all before constructing the fuselage. The objective is to have as straight a rudder cable as possible and save time and agony in later phases. JJ85/3

Plans 5‑3: If you thought to install a vent in the side for your back seat passenger to control, consider Ian Ayton's adjustable NACA vent (library item #9c.

CHAPTER 6: FUSELAGE ASSEMBLY

Plans 6‑2: plans imply longerons go through the plywood firewall, not fiberfrax or aluminum

Plans 6‑2: Use two 1" wide loops of auto inner tube joined together and stretched on 2 x 2s for adjustable jigging.

Plans 6‑2: If the fuselage sides are difficult to move into place while jigging, ease the nails part way out of the bulkheads.

Plans 6‑3: #5/2; A good way to remove excess Epoxy from BID tapes is to overlay a paper towel on tapes and lightly stipple with a dry brush, repositioning the towel as it becomes wet. Be careful not to make the lay up too dry.

Plans 6‑3: Make your tapes by putting down aluminum foil and overlaying with any size BID then trim BID and foil to size, fold foil, place bid in place, smooth and remove foil. JJ84/3 SQ1 advises using saran plastic wrap.

Plans 6‑5: When the fuselage sides are in place, you can easily construct the speed brake hardware in place. Getting into the corners when the fuselage is constructed is harder, messier and slower. When the bottom is off install the landing gear.

Plans 6‑5middle of page: Where plans say to place 2 ply down the forward face of the bottom, this apparently infers you should round the top front edge of the 2" foam bottom. JJ85/4

Plans 6‑5: Florida builders suggest you place seat belt anchor holes in the longerons by predrilling a wooden

block about 1" high so that you can use it as a guide to placing the hole straight through the longerons for maximum purchase before glassing the outside. Plug the hole with a little plug that can be removed from the inside.

EPOXY RASH: "The straight skinny eludes us."

By now, under 10% of the builders are suffering rashes. They appear to be little frustrating welts that can cripple a project. Why not listen to the experts (i.e., nobody knows what to do, but here's the EZ‑wives‑tales):

1. If once you develop an epoxy rash, it develops later at the drop of a hat or a relaxed precaution.

2. Those beautiful little doctor's examination gloves allow the aroma of epoxy through to sweaty, open pored hands. More than one builder has developed rash after the first time he tried to protect against rash by using them.

3. A good 40% of the builders never use more than Ply 9‑never get rash.

4. Nobody has yet shown me rash after using butyl rubber gloves (thick & clumsy). To make them last longer put the doctor's examination gloves over them.

5. Others find the thing that gives them the rash is the powder in the gloves, so they use cotton liners in the gloves.

6. There is a lot of sympathy out there, if you help him sand, the other guy may do the big layups with or for you.

7. One guy connected with a doctor to cure his rash, the doctor prescribed a steroid or cortizone, the builder found he could suddenly get 22 hours out of a day, until he crashed for 36 hours.

8. One builder says he correlates the chance of rash increases with the age of the builder‑balderdash.

9. Some people believe that the sanded cloth fibers prepare the skin for a good dose of epoxy rash, in other words, wear your protection when sanding, particularly gear and spars.

10. The manufacturer assures us that Safety I is hypo allergenic and Safety II is even more so (?).

11. One fellow suggests that lighter skinned types suffer more chance of a rash. Congratulations to those who qualify.

12. It could be that you are getting reactions to MEK, solvents and such. Don't use them on raw skin. Try not to use anything but epoxy!

13. We heard the most unlikely story: A fellow with SAFE‑T‑POXY rash, switched to RAE and is building without symptoms! It required a change in his Sticky Stuff dispenser, quickly carried out by Michael Engineering, 4997 So. Crawford Rd. Mt. Pleasant Mi. Mike Prewett, 517‑772‑4073.

14. Nerve Damage: Byron Crambet, 64, San Diego builder just sold his project on his doctor's orders because he has irreversable nerve damage which manifests itself in loss of feeling in his feet. The doctor is not sure that Safety Poxy is the cause, but based on Byron's project history the doctor is concerned enough. The doctor recalls the late 70s problems where glue sniffing kids were bound to wheel chairs when they lost the use of hands and feet due to irreversible nerve damage in those extremities. AM86/16

CS' Davenport on Alergy. He has spent over $2250 on various tests to chase down a persistent cough and frequent virus attacks‑his and his allergist's advice? Wear a mask whenever in the shop! Glass just floats around all the time and causes irritations which make the throat a raw receptor for the next virus.

CHAPTER 11: ELEVATORS

Plans 11‑1 The new Rutan canard may have new hinge system too. So if you wait for the new canard, await ordering metal too.

Plans 11‑3 step 6: When mounting CS3s and flox is still wet, be sure you can run a pair of tongue depressors in the gap both from top and bottom of canard to elevator. Later, the elevator will have full range, particularly in up elevator position.

Plans 11‑4: When drilling lead CS11s‑oil the drill frequently to avoid "gum up" of lead.

CHAPTER 12: CANARD INSTALLATION

Plans 12‑2: Some builders gill the fuselage gap over the canard by skipping to Plans 24‑3, if you do, (ON83/2) Don't finish off the foam you mount on top of the canard during installation, rather wait until shaping canopy so that both can be shaped smoothly together.

Plans 12‑2end: After canopy and canard are glassed, use a plain old crosscut saw to cut a nice smooth line between them, but don't cut into your longerons.

Plans 12‑2: Canard attach bolts must not be loose, drill out and place larger ones at need. If you have to, tear into your canard forward of the sheer web and place new tabs in and redrill.

CHAPTER 13: NOSE AND NOSE GEAR

A Nose Light.... Burt designed one in the old VEZ aircraft. There is rumor that the San Diego crowd made a lot of them and cracked a lot in flight. I used the method, mounted a light and have been happy to fly with a light on in the LA basin, without the extra drag or lost instrument panel space from the standard bottom light. The lens is a little cloudy. The effort took about 3 times as much work as I would expect. I broke a lot of plexiglass in the building. I recently rebuilt my nose to a near-Ronneburg nose, used a standard aircraft light with a plastic mixing cup as the mold, I used fiberfrax and silocone to fix it in the nose. I think the light in the unused tip of the strake with a simpler bent plexi makes a lot of sense too, but the glare from a light behind you may give a little more trouble in weather. The guys at Santa Monica are starting to use little 1.5 inch reflectors with extremely bright lights.

Long Nose.... These are a dime a dozen, I prefer the Ronneberg design, first designed by Eric Cobb. But the real advantage is to get the battery out of the living space where it won't gas you or burn you; with a bigger engine, it helps with CG concerns. Central States newsletter editor, Terry Schubert now has a backup set of templates for the Ronneberg Nose, but I can create a set of templates for about $15, sending $10 to Dave Ronneberg as an unofficial license. I would put them in a mailing tube if you like.

Plans 13‑1: Several builders are designing electric nose wheel retract systems.IV27 By far the best is by Bill Oertel 909-734-7569.

Plans 13‑1: Clayton Kau suggests a simple hole through the step will provide purchase to rig a nose tie‑down than the plans one. ON85/10

Plans 13‑1right side: #6/4 When sanding the Nose gear S Glass, use full cover clothing and a mask. The Glass is very penetrating.

Plans 13‑1 CS Sep86/1: Herb Sanders says his NG3 and NG4 have deformed twice on taxiing off the pavement at Oshkosh.

Plans 13‑2: One builder from a major gear manufacturer suggests you preload the main gear (largest gear) by putting washers to bring the sides out far enough around gear bearings to actually torque the sides in a little bit. The object is to get it no more tighter than necessary to make the gear stay at any place in its travel without falling the rest of the way by gravity. See library item #51 or DJ85/13 and ON84/4,5 for drawings. CS's Jamison suggests a washer to take up the slack worked, CS Ju86/4.

Plans 13‑2: Ron White, CS has produced a lock for the crank handle that is a second way of limiting the unintended gear retraction on the ground. See Library Item #

Plans 13‑4: DJ85/4 One builder suggests plans are not well thought out on nose axle bolt. He suggests making the axle bushing a snug fit into taper roller bearings and then add spacers as Rutan recommends. The spacer has to be a good fit to allow very little play between the taper bearings and their races.

Plans 13‑4: Bob Davenport of Florida has designed two shimmy dampeners with plans and parts for $21.65 including postage. See ON85/4‑6. Mike Melville is thoroughly convinced of the good of the Davenport Shimmy Dampener. Before it he made a ritual of lifting the nose of his aircraft to crank the gear, when down, he would kick the nose wheel. If it spun around, he would adjust the tension to 2 1/2 lbs to 5 lbs. Now it doesn't go out of adjustment as much. He thinks that tension is the key cause of lost nose wheels, nose gear strut failures and the like. He also feels using an AN3 instead of the 525 flat heads in the nose gear is a good move too.

Kept reading about nose gear failure due to Gear shimmy, so I had one made up for mine and  several extra. Made to Davenport's specs the Kit includes all you need for the conversion.with Drawings and instructions.  
$110.00 shipped (U.S.) Please call if you have any questions 951 245 8479 wband.cc@verizon.net

Plans 13‑5 step 2: #13/4 Install Nose Gear down switch before nose box assembly. See also Davenport's drawings on this AM86/23.

Plans 13‑5 step 2: Drill all holes possible on the NG60, 61, universal before assembly at gear of fiberglass box. One builder suggests you even put another one inch diameter hole at the right rear of the nose box next to opening on rear for gear crank handle to provide a place to access the bolt holding the gear crank to gear.

Plans 13‑5 step 2: When constructing the NG30, one builder suggests making all the hard points out of one stock piece of compressed glass. Nail down a 6" x 8" box made of scrap 1/4" foam on a saran covered table, lay up all kinds of trash bid and weigh down flush with the foam box. When done, cut out the various shapes needed with a band saw and flox them into the holes in the NG30.

Plans 13‑6 step 3: The Kreidels modified their nose to be fuller and rounder. If you are interested in seeing how they did it, in Squadron I ask Dick Kreidel, in Squadron II, ask David Orr for Kreidel drawings. There is also a sharper flatter nose being standardized by Ronneberg at the Hole in the Wall at Santa Monica Airport, one of its benefits is to move the battery forward and out of the cockpit entirely.

Plans 13‑6 step 6: A neat trick reported by one builder for placement of static tube and ports is to drill your three 1/16" holes through the whole virgin side of your fuselage, then use the inner holes to guide you in clearing out foam for the crimped static tube. Then slide the tube in, carefully looking through your three holes to be sure you center the tube and drop below the last. Then carefully drill again but only through one wall of the tube. Otherwise you will have an inside and outside static port.(ON84/2)

Plans 13‑7: DJ85/3 One solution on making the anchor bolts removeable on the back of the canard lift tabs is shown in detail in article, essentially the anchor nuts are mounted to .063" aluminum "mounted in saran wrap, floxed and covered in 1 layer of BID. When dry, break free through slot in the top. Then you can rivet in new nut plates as the old get tired (after 3 uses!).

Plans 13‑7 step 4: Many suggest never using green urethane foam, but instead some blue scraps from someone who has done wings already.

Plans 13‑7 step 4: There is a liquid urethane foam that is useful in gluing blocks and filling voids on the nose. (see notes on canopy section.)

Plans 13‑9bottom: Several builders have had the idea of lower the location of the nose gear crank to make room for that illusive "one more instrument"‑ they then move it back up again when they realize the landing light handle blocks the nose gear crank when the light is retracted.

Plans 13‑9not in plans: It is a good time to do the landing light if you want the Brock type. The stock Brock landing light bracket stiffener (that horseshoe shaped bracket) is oriented 90o off, remake it so that it does not conflict with the bulb electrical pins when you orient the beam parallel to the ground instead of perpendicular to it as Brock suggests. Also, change the point where the push rod touches the strengthener so that the light can actually come down 100 degrees instead of the planned 90 for taxiing.

Plans 13‑9: CS's Jamison suggests that for air leaks the landing light has to have an air tight cover. He finds the light reflects into the cockpit, and visually checking the nose gear window is blinding. CS Jun86/4,10

Plans 13‑9: Rutan designed a nose light for the varieze, Manual Section III. See library item #18. San Diego builders say that a Rideout lense was available but proved to shatter on bug strikes at speed, so they have their own mold for their replacement. Another option is to place light(s) in the ends of the strakes. The author has seen only two of these including the ARMY Long.

Plans 13‑9 step 5: Don't be surprised if the Strut Cover "SC" is substantially cut up by the time you are finished with it. Note also that the Nose Box "NB" is too shallow for your wheel, many have had to raise it up to 3/4" off the floor.

Plans 13‑? You may consider leaving the wheel cover 1/2" high so there is room for a mud flap on the front wheel.

Plans 13: Gear supplier: Lombards is now called Featherlite Products Inc. of POBOX 781 13451 Airport Rd. Boonville 95415. Jim Nickless makes a run up there quite regularly from southern california if you need gear shipped free.

Plans 13‑10 step 6: Weldtech makes a very professional looking (heavy?) pitot tube, see library item #98. Stan Schneiderman is having a very nice, but smaller pitot tube built up. Melville suggests that the solution is to cut the regular tube off within 1/4" of the nose glass so that the thing can't get hurt.

Plans 13‑11top left: Some builders have placed steel plates under the

bumper for the possibility of gear‑up landing. Some suggest this plate will simply transmit the shock to the nose gear bearing and fiberglass structure instead of letting the nose glass and foam grind away. Either way, don't use a teflon plate, it grinds into a poisonous gas.

Plans 13‑11 step 9: Why close up the nose section after you've built your nose door? Wait until the radios are trial fitted.

Plans 13 end: On gear doors for nose, Davenport has plans and parts for $159.95 AM86/22‑24.

Plans 13: CS Sp87/11‑14, George Nelson has done a four page study on a small round section or parabolic nose for Long EZ.

Plans 13: For a tretise on Pitot‑Static System Testing, Library Item #38H, Spt.Av. May87/37.

CHAPTER 14: CENTERSECTION SPAR

Plans 14: Dave Ronneberg, at Santa Monica Airport, builds spars for $1700. Contact him at 213‑488‑7173. Didier Makowski competes, 213‑397‑4110.

Plans 14‑1 Most builders notice after they have installed strakes that the last 8" of the upper surface of the spar (with overlays) project 1/4" up or down into what would be the ideal surface of the wing/strake, this requires a lot of preferably bottom fill. If, when you build the spar, you could slope the last 8" of the spar somehow, while leaving the sparcap material and metal exactly per plan, it might make a better final result. Quite a few builders simply sand down the "non‑structural" parts of the spar forward end and reglass it.

Plans 14‑1 step 1: Others have built jigs and trough templates for building the centersection spar. We make no representation that they are accurate. You are the builder. Confirm all measurements and shapes before building. Mount the trough templates on firm material and use them to scrape out urethane. Many builders who have finished are very "down" on the long term properties of urethane. Blue foam can be found at any hanger where the wings are cut, it is not a good replacement, but brown, fuselage foam is good, and a little harder to use.

Plans 14‑1: where the inside lay ups are made in the spar, it is impossible to interpret the plans about the 5" wide BID and 1" overlaps. Be guided by the following thoughts: 1. You don't want the 1" edge to be under any metal plates. 2. If you are going to extend BID 5" in any direction, why not make the piece that extends out from the metal plate the longer dimension.

Plans 14‑2 step 4: #13/4 Pre‑lay Center section spar wiring before closing up the box.

Plans 14‑2 step 7: AM85/4 Mike Melville suggests that the 3" unidirectional glass runs in different thicknesses, so rather than being too thin a spar, why not lay up glass to fill up the spar trough (use a straight edge accross the top to see whether space for one more layer exists), you may also wish after you lay the glass in the wet trough, but before each layer is wet out, to pull out the running thread that releases the cross fibers(found on one side of the 3" UNI) and then pull out the cross thread. Be sure not to bunch the bundles up or cross them over each other. The result is a very much easier to wet, smoother layup. Safety II also wets these things out very much faster.

Plans 14‑3 step 7: Beware: When sanding the thick UNI, realize it has the same property as S Glass and will give you the itches for several days if you don't wear full protective gear.

Plans 14‑3 step 8: DJ87/3 Joe Heapy points out that positioning the wood in the Center Section spar is critical ‑ otherwise you might miss the extrusions.

Plans 14‑3 step 8: One builder suggests it is easy to do step 8, layup #6, upside down by mistake, realize you will be leaving one foam surface (front) uncovered. Just to avoid the mistakes of many before you, draw in the spar cap position on the drawing "Layup #6" on plans page 14‑3 before you start.

Plans 14‑4 step 10: Don't forget that the forward section of the spar forms a rear tank surface, mark off the applicable area and lay it up wet to avoid pin holes, unless you are going to the urethane tank coating by PRC.

Plans 14‑4 step 10: Ronneberg suggests that so many people have sanded into the metal parts that he suggests adding one ply of UNI right over the final metal lay ups, just so you can save the vital layups there. You are particularly blind in the multiple times you separate wing from spar when doing finishing. AM86/13

Plans 14‑4 step 13: Mount the canard and use a water level to get spar parallel to canard and of course level with the fuselage level. (a water level is a 3/8" to 1" diameter clear plastic hose open at both ends, (with plugs to keep colored liquid in when moving it around and storing it) make it long enough to reach from canard tip to firewall, with 3' to spare.

Plans 14‑4 step 13: The firewall will be level (perpendicular to ground) or not depending on the fit against the spar. Why not trial fit the firewall and trim and jig the spar as necessary, always leveling it.

Plans 14‑4 step 13: At the end of the mounting procedure for the center‑ section spar, you place the extrusions to go through the firewall. Why not get the engine mount first so that you can get a perfect, stress free fit?

Plans 14‑4 step 13: Clarification: If you haven't done LPC #20, do it now. On page 14‑4, step 13, note there is no drawing for the below spar area, nevertheless, LPC #20 indicates that the 15 ply pad for your aft gear extrusion does not extend all the way up to the center section spar hole.

CHAPTER 15: FIREWALL AND ACCESSORIES

Plans 15‑1: AS83/7 See Light Plane Maintenance article on Hardware Failures.

Plans 15‑1: DJ84/8 Article on safetying bolts.

Plans 15‑1: Note that the extrusions come through the firewall, the longerons come through only the plywood portion.

Plans 15‑1: The construction cross‑section on the bottom left of the page doesn't show the washers and bolts. Use one MS21042‑3 per nut and an AN960/10L washer on top of the CS72.

Plans 15‑1 step 1: Time to buy aluminum and fiberfrax if you did not in chapter 4.

Plans 15‑1 step 1: Materials: There may be some good substitutes coming up for present firewall materials. Check with Squadron 1 Materials committee before you fabricate firewall.

Plans 15‑1 step 1: Technical committee: there are plans on a cabin heat system incorporating holes in the firewall and avoiding the need for an electric heater. Wait until Chapter 23 to make holes for it. Combine with a carbon monoxide detector.

Plans 15‑1 When to apply it? The FRC‑1644 sold by Wicks for $65.47 per gallon and $25.75 per quart may be better applied by brush. It sure clogs up the gun. Some Central States men suggest you should put some lacquer over it to keep it from getting dirty as you build. Maybe you should rig everything except your tie wraps and then pull the engine and apply the fireproofing.

Plans 15‑2 step 2: #10/1 When drilling to mount things on the Firewall, don't drill into the spar caps and shear web on main spar.

Plans 15‑2 step 2 & 3: With the firewall crowded, four different builders have developed plans for running the brake lines directly to the front of the aircraft and mounting the brake masters (indirectly) to the rudder pedals. You may not want to have hydraulic fluid running around your fuselage too. See chapter on brakes above.

CHAPTER 16: CONTROL SYSTEM

Plans 16‑1: For Squadron 2 articles on Hardware Failures #54E, Cable and Terminal Connections #54C and Control Rod Ends #54D, May 83/26.

Plans 16‑1: Fred Griffiths, Great American Propeller, had his controls bind up on a test flight in a VariEze. He believes the long safety pins on the firewall were the cause and sould be reduced on VariEze and LongEZ. AM86/13

Plans 16‑1: You need only about half of the supplies for the first part of the chapter, the rest after chapter 19(6 months later?). The parts price list divides out the supplies so you can save the expense of ordering unneeded supplies.

Plans 16‑1 step 1: #7/5: Don't bond consoles until end of the whole project!

Plans 16‑1 step 2: If you don't bond consoles in, what do you do with CS109 and CS118 ‑ why not prop them with scrap foam accross cockpit (against console) and glue with five minute, then remove consoles and lay up 1 ply Bid on each face, overlapping onto fuselage. If you have "ZAP‑A‑GAP", even better.

Plans 16‑1 step 1: should you make the consoles removeable? Mike Melville is of the opinion that consoles do stiffen the fuselage. They were intended to serve as structural members. When wing and canard act in different directions (as they do in every turn) the front fuselage takes up the torsional load. Besides, he believes that cutting out the console and refloxing it is less work than installing heavy removeable console fittings.

Plans 16‑1 step 2: #10/1, AS83/2 Sam and Dick Kreidel have manufactured front and rear Control Sticks which eliminate the wear and slop inherent in the basic plans design.

Plans 16‑1: Task Strakes aren't exactly to plan, so if you cut out your fuselage sides for baggage holes early to give better access to your control system, cut them out narrower and then trim out to strakes later.

Plans 16‑4: Note: The plans miss (2) AN316‑4 (you can use MS21042‑4 which have been tapped out) (see

Plans 16‑4 top left) and (4) AN100‑4 thimbles to go over CS17 on (fuselage section of) Rudder cables (see

plans 16‑7 middle). It is worth having another rudder cable and swedges on trips – finding the right equipment to replace a rudder cable on a trip can be problematic – may take days. (I carried one for 15 years before needing it – but it was good to have in place for immediate repair.)

Plans 16‑4: On stick grips, one builder used ski pole grips‑ fancy ones can be purchased from large ski rental places quite cheaply, from wrecked ski poles, get two rights of course. Putting a transmit switch in the top is pretty easy.

Plans 16‑6: For clarity: AA, CC, DD and FF you are looking forward. In BB and GG you are looking aft, and AA fits below DD.

Plans 16‑7top: To avoid minimum wear and friction, Brake line conduit should be as direct as possible between pedals and belcranks, belcranks to rudders.

Plans 16‑7top: If you are planing nose brakes, why not use the lighter cable, appropriate for rudders only, from pedals to rudders. Untried so far is the idea of getting rid of the aft belcrank entirely, routing the cable directly to the pulleys and turning the pulleys 90o to the firewall with cotter pins around the aft side to keep cable on pulleys, or move the belcrank to where the pulleys are. Watch out for the spars when drilling anything there. AM86/13

Plans 16‑7 ON83/2,6a: See plans for putting in Co‑pilot controls.

Plans 16‑? Arnie Ash 319‑386‑5245 indicates that rear seat throttle controls can be made by removing the lever from the standard Brock unit and making a new lever with an additional arm at the 4 O'Clock position when the throttle is at idle. This new lever is then riveted back into the "spool cable" assembly and replaced in the Brock unit. A similar "arm lever assbly" is made and installed in the rear area. These two levers are then connected either by means of a push pull cable assm. or utilizing some alum. tubing.

Plans 16‑7: Don Douglas has moved the adjustment portion of the rudder cables forward to the pedal attach itself (all nuts facing away from your legs) for easier access from the front of the aircraft instead of from the cockpit.

Plans 16‑7top: May83/17: Sport Aviation Article on Control Systems and cable terminals is a must.(library item #54E).

Plans 16‑7 step 4: #5/2: Secure rudder cable conduit by 1" by 2" BID tape, cut on 45o, to fuselage side from instrument panel to 2"‑3" beyond control stick to avoid entanglement between controls and conduit.

Plans 16‑7 step 4: DJ85/3: Before floxing/taping conduits, slide two 36" long pieces of 3/32" piano wire into the conduit, this will hold the conduit straight for bonding.

Plans 16‑8 AM85/4,9: Bill REID's rear seat throttle and mixture control diagrams are depicted.

CHAPTER 17: ROLL/PITCH TRIM SYSTEM

Plans 17‑1 step 2: JJ83/2 For more control authority, Herb Sanders has compression springs which have U‑shaped wires down the inside of the spring which attach to PTB assembly.

Plans 17‑1 step 2: Ian Ayton planned his radio panel before the realized the trim system springs cross diagonally up the left side behind the panel. He therefore led the springs to a bell crank straight forward and ran a push rod up to the elevators. The radios fit beautifully. Unexpected bonuses: 1. The canard is easier to remove. 2. There is no constant tension on the aileron bearings (7 of them) which would lead to more wear. 3. Ian was able to place a full 2 ply bid seal under the canard mount with only a gasket area for this new push rod and the rod on the right side.

Plans 17‑3 bottom left: You will probably router out a trough accross the PT1 between the 2 bolt holes for the rudder cable.

CHAPTER 18: CANOPY

the hydraulic canopy arm.... They increase your safety by forcing the canopy down even when you don't lock it down, and for keeping the canopy stable and up in the wind, the $20 strut from Spruce or some Auto type from Pep Boys makes a lot of sense, compared to the scissors type in the plans.

Back Head Rest.... The plans position forces the back seater's head forward. We all modified our canopy to turtle deck cut about 2" back to make the head rest more comfortable. The Melvilles tuck a bag into the turtle deck and cut out the cross tubes and head rest altogether. What a good idea, but don't put any head smacking items in the bag.

Front Deck.... Some people leave the front deck off to install the instruments and then make the front deck removable to make ease of service a priority. It looks a little "dicey" as far as strength is concerned. Likewise, once you have installed the panel equipment from the top and closed up the front deck, you have a devil of a job getting anything out through the leg holes. Installed from below is easier to remove from below. A removable panel along with a removable deck would be courting death, if I understand the up forces generated by the canard.

Rain Lip.... I have seen various rain lips which channel water from the front canopy edge back to and out of the longerons by way of simple tubes.

Consider having the canopy leading edge aft of the instrument panel. Then the top of the instrument panel can be structurally joined inside the top fuselage with corner tapes fore and aft. That adds strength and allows an access hatch to the instruments forward of the instrument panel.   
My canard cover is not attached to the canard and is a hollow storage compartment (sectional maps for the coast i am not on-in a baggie), and allows easier canard installation. Walls fore and aft of the canard cover keep things from falling inside or into the elevator tubes. Those two removable access panels plus the nose hatch are held in place by two pins (1/8 inch stainless welding rods) in plastic tubing going forward through the instrument panel and forward inside the top skin, going through the hatches along their top inside skin. All done after the fuselage nose and canopy were built. Most folks are glad they installed a rain drip rail on the lip forward of the front canopy edge. (A note here - often someone will object to having the canard cover detachable because of supposed loss of strength in the structure there. The proper concern is actually when the top area over the instrument panel is made to be removeable. Not what i am talking about. I have actually strengthened this area by tieing in the top of the instrument panel with structural corner tapes fore and aft).  
  
Best to you- Bill James [bill@skybeyond.com](mailto:bill@skybeyond.com)

Vents.... If you don't use Ian Aytons nifty NACA vent, the good way to make a door for the vent is to buy the ready made one from the mid‑west builder. While I'm on vents, I also installed a rear vent through the fuselage under the strake to point up by way of eyeball vent knob to the passenger, Ian's would have done there too. I was afraid of claustrophobia in my passenger. Because of the canopy and wing windows, it turns out that the passenger is whatever the opposite from Claustrophobic is. AYTON: 2950 Old Calzada Ave. Santa Ynez CA. 93460 805-686-4106 (H & O).

Simple canopy lock.... Many people realize a simple lock and key can be put in the side of the fuselage and lock the canopy latch just behind the position where the handle moves into the safety catch. This simple 5/8" hole completely replaces the Rutan 4" x 4" canopy door. The standard Rutan canopy door does provide more access to rescuers, thieves and cold air.

Plans 18: To get a good line from nose to spinner, you should rent the Cowl videotape from Sq 2 library. The planning starts with the canopy.

Plans 18: The direct supplier of canopies now Walt Hoy of The Airplane Factory, Box 24035, Dayton OH 45424 513‑849‑6533.

Plans 18‑1: Bill Reid has engineered and built a full width canopy for greater inside room, and little reduction in

total drag‑by his calculation. He would start by not rounding the upper longerons, were he to do it again.

Plans 18‑1: You will find 2 qts of Spraylat will give you 4 layers coverage both inside and outside. Do all surfaces, peel back locally after cutting for sanding.

Plans 18‑1: The canopy rates special storage, handling and planning. One of the best surfaces to put the thing down on is a foam rubber pad. The spraylat does help. One builder forgot to replace the hinge pins and dropped the canopy in its frame on its top on a lino floor from 4' with no dire consequences. The inside of a blown canopy is much more vulnerable to attack by sharp items.

Plans 18‑1 One builder says its easier to leave the entire top of the aircraft intact while laying up canopy outside, (from F‑28 to Firewall), then carving inside and glassing, then later separating into three parts. To do this gray tape the entire longeron, firewall top and F28. When doing the inside, carve away all foam for 1/2" on both sides of seperation and lay up glass to glass. Then rather than cutting completely through, serate, leaving little attachments, lay gray tape up on canopy side of cut and lay tapes affixed to turtle deck and extending onto gray tape on canopy. When dry, carefully cut remaining serations and pull off canopy from perfect lip.

Plans 18‑1 Ronneberg has been advocating moving the canopy aft end back a few inches to give the back seater a more natural head rest location. If it is too late, we have seen canopies without the arrow stock in the aft end and this aleviated the crooked neck problem with the rest on the arrow stock. CS's John Jamison echos this CS Ju86/4.

Plans 18‑1 Of note, the canopy layups at warm temperatures results in quite a constriction in cold temps. One builder put wet blankets on the canopy itself and blew air on it to keep the canopy cold while the epoxy set. Others suggest a more sophisticated seal. See CS's Jamison CS Ju86/5. Library Item #54K. His other suggestions are a drain on canopy door, trim the glass about .25 below the longerons to both provide seal and centering, cut the front off behind the instrument panel to protect the instruments and avionics‑the Naca vent has to be downsized, he also has ideas on making seals elsewhere by overlapping joints, a hinge for a Naca vent door, anda canopy defroster.

Plans 18 Florida Feb86/8‑14: For an interesting detailed plan for installing a instrument access door just ahead of the canopy, see Debbie Iwatati's plans.

Plans 18‑1 step 1: One builder found that a japanese draw saw leaves a much smoother plexiglass edge resulting in easier sanding to fine finish, but don't use it on the sharp front curves, too many chances of nicks. What ever you do, don't move the canopy around until you have finished all edges, cracks propagate very easily. Don't use any kind of jig saw.

Plans 18‑1 step 2: Before you start this on and off the aircraft session, use some green scrap and put a mushroom shape over the rollover structure to avoid a pretty hole in the middle of the canopy as you manuever it around the structure!

Plans 18‑1 step 2: After gray taping the canopy, go back and check it for symetry, particularly in front 2 feet, the glassed painted surface runs up to it and can be seen head on. Before you remove the canopy frame the first time, locate the naca vent position and look at it carefully from the front. Incredibly, half the planes have crooked vents.

Plans 18‑2 step 2: ON83/3: You may be better off moving the canopy forward 1 1/2" to 2" for better view of top instruments if you fly instruments a lot. A number of people have also raised the canopy for stronger side rails, bigger panel and more wetted surface.

Plans 18‑2 step 3: While you can do canopy and engine extrusions out of order, you'll need a 90o drill attachment to drill bolt holes in the extrusions if your turtle deck is already on. JJ85/4

Plans 18‑2 step 3: #5/2 Materials: There is a good one‑shot urethane "instant" foam ("X40") which is available to fill all the voids around the canopy, instead of micro.

Plans 18‑2 step 3: Instead of using Pour‑in‑Place or X40, one builder suggests a 2 lb urethane from Hastings Plastic in Santa Monica in quarts or Gallons. It seems more uniform and stronger.

Plans 18‑2 step 4: If you shave or sand off your green or blue foam to the point it is too weak, cut out a triangle trough of foam, back the hole with scrap and use Pour‑in‑Place or Hastings urethane, then resand.

Plans 18‑3 step 4: AS83/3 If you can, mount your engine and balance your top cowl in place before you fare your rear canopy into the cowl area to avoid the possibility of a profile which dips at the firewall.

Plans 18‑3 step 4: To really fair canopy to cowl, mount your cowl and engine now.

Plans 18‑3 step 5: One builder achieved a nice tapered edge at fiberglass into the plexiglass by first placing silver tape 1/4" in from plan location, then laying glass up 1/4" short of the tape, as nearly as possible, and then laying a 1" wide uni with selvage edge along the tape. At finishing, the tape was moved back another 1/4" for filling and painting.

Plans 18‑3 step 5: Don't fail to knife trim after outer canopy layup, and before micro. It is difficult to find the correct line for cutting it off longerons otherwise.

Plans 18‑3 step 5: Two aerodynamicists have suggested that if Canopy and canopy rail (outside) meet at less than 90o, the parasite drag is increased many fold, why not a nice smooth fillet of flox along that line, but don't be too fat with it, remember the lower canopy is where you obtain runway information during landing.

Plans 18‑?: Before doing interior lay up on canopy, be sure to get into the aircraft after carving, have someone put the canopy over you and then being sure you have about 1/4" of space over the instrument panel so you don't end up with the whole canopy sitting up on the instrument panel after the layups are done.

Plans 18‑3 For article on use of Hinges, see library item #54H.

Plans 18‑3 CS: See Nutting's Hinge Alignment article, Library Item # .

Plans 18‑3 step 5: You may wish to consider Ian Ayton's ready made adjustable NACA vent. Ian also makes a nifty canopy/gear etc warning box. See library item 9C. AM86/3,11.

Plans 18‑5 step 7: JJ84/6 Kreidel drawings for putting the mag compass up in the nose of the canopy, instead of the vent.

Plans 18‑5 step 7: FM85/ Kreidel drawings are included for recessing a canopy seal and installing lights through the canopy rails.

Plans 18‑5 step 7: #10/1: Seal any gaps in the cockpit and canard area to minimize any leaks into the cockpit.

Plans 18‑9 step 14: One builder suggests skipping the canopy door latch as a screw driver can bend it back for easy theft. Instead, install a hidden lock accessible through a single 1/4" hole and a long shafted key or allen wrench. The moving eccentric goes against the forward end of the rod end when engaged. Unfortunately, you are sacrificing "easy rescue" as most people don't know how easy it is to break a canopy to get to crash victims.

CHAPTER 19: WINGS, AILERONS/WING ATTACH

Zap-A-Gap.... What a building tool. But it can also "fix" your wing bolts while you are wrestling to mount your wings.

Plans 19: Dave Ronneberg builds wings with ailerons for $2450 each and $2100 each without ailerons cut out, 213‑477‑5958. Didier Makowski competes at 213‑397‑4110.

Plans 19: There was some chance that Tom McNealy of Phoenix might do some builders sessions with a group of builders, but it hasn't come off yet. AM86/12.

Plans 19‑1 Get blue foam from a direct source in full size billets for

considerable savings.

Squadron 2 Library items:

9B: Weldtech catalogue on parts (CS122/124, 132L, 132/133).

: May 83/8 Finishing article, read them now

Plans 19‑1 step 1: There are a number of wing templates and jigs floating around. Be sure they conform to you plans before you build, neither clubs nor any other amateur you deal with can give you the peace of mind of knowing where your errors are.

Plans 19‑1: Some people are using stainless steel allen head flat head bolts instead of round headed ones on hinges etc. These little things are $19 per 100 through Soc‑Pro Inc, 4647E.\_Washington Blvd, City of Commerce CA. 213‑268‑3421. We find we need 10(Diam) 32(thred) 1/2"(length) and you need from 30 to 50 per plane depending on your infatuation with them. They also require a sunken timken washer. CS Sp87/2: You can also order a minimum of 200 c/o an East Coast Distributor for only $134.

Plans 19‑1 step 1: If you build jigs, cut them in 4 before you glue the patterns on them to avoid shortening all the dimensions in all directions.

Plans 19‑2 middle right: Instead of attaching a 2" wide scrap as shown on the middle of the left drawing on plans page 19‑11, cut out a 2" deep piece and place in a 4" deep ;iece which avoids a difficult feathered edge in the leading edge which is awkward to work with until skinned.

Plans 19‑2 step 3: When placing 2‑3 blocks together for wing sections, place them flat on the table and rub the mating surfaces together so that the glue faces mate over a greater area. To see when they are mating, feel for a uniform warmth after rubbing.

Plans 19‑2 step 3: To get an absolutely even trailing edge thickness, modify the bottom of the templates to a straight trailing edge (no notch on bottom matching the top surface) and when the bottom is slurried, stick down peel ply on the last .6" of the trailing edge. When the bottom glass is cured, shave off the excess blue foam as usual, then pull up the peel ply and the notch of blue foam on the top, transition the blue foam into the notch. Lay up the upper glass down onto the bottom glass and use dry micro to fill the resultant trough on the top instead of the bottom.

Plans 19‑2 step 3: Several builders not that the shear web end of waterline (17.4) on the buttline 23 drawing should be lower .25" when compared to the outside jigs. The plans waterline is not perpendicular to the shear web unless you make this minor change. If you don't understand the design concepts, don't even play with it. But realize the wing from spar out is what you worry about straightening on mounting, don't worry if wing near cowl is not perfectly parallel to waterline, in fact expect it to vary.

Plans 19‑2 step 3: Glue blue foam blocks together (front/aft) with 5 minute at waterline only, glue blocks to table with 3M "77" or micro and weight down everywhere before you hot wire. Be sure to make the shear web cut. Never move the blocks or weights until the entire part is cut out, including the top, bottom and spar notches. Leave the remnant glued down and use this as a more precise jig for microing the block together before puttin them in the plywood jigs (which are less precise for the same gluing process). Others have used Hastings two part foam or X40 with firm but slightly expanding gaps. They rub the blocks around before the stuff sets to kill the expansion factor. One builder keeps the foam cold in the fridge to delay setting time.

Plans 19‑2 step 3, middle right: To do for the wings what the dowls do for the canard, use sharpened 16 pound nails driven in on angles from above and below, avoiding the area that will be the spar cap. Then remove them and cut your leading edge off, marking the holes with felt tipped marker so you can locate them through the shear web glass. Replace the leading edge before complete shear web cure, replacing the nails through the weave. To break the nails loose later, turn them with pliers before pullin on them.

Plans 19‑2 step 3: It may be better to use wall board screws (i.e. #8 x 3" multiuse) driven into the foam blocks with a drill, they tend to hold better than any nails do.

Plans 19‑2 step 3: The jigs are not exactly straight if you follow plans. There are some improvements possible. Run strong and straight "stringers" made from aluminum box 2" x 1" tube, especially under the trailing edge, but also along the spar trough or when one side is done, along the completed spar. Always use plans page 19‑10 as your bible.

Plans 19‑2 step 3: One builder suggests that you place 5 3/4" of peel ply down on the fuselage end of the wing sheerweb foam before you lay up the sheer web. Also place peel ply on the foam before you glass the edge near the fuselage‑see later plans where you will be stripping out the foam under both of these areas. Micro it in place rather than using pins or staples.

Plans 19‑4 step 4: When locating LWAs in foam before sheer web (plans page 19‑4 lower left drawing), ignore the 1.15" dimension and be sure that the center of the two LWA4s are exactly the same distance from the LWA6 as the corresponding mounting points on the Spar. Transfer this calculation to each metal part you add here.

Plans 19‑4 step 4: One builder suggests that you place 5 3/4" of peel ply down on the fuselage end of the wing sheerweb before you lay up sheer web(under glass), also place peel ply on foam before you glass edge near fuselage‑see later plans where you will be stripping out the foam under both of these areas. Micro it in place rather than using pins or staples.

Plans 19-5: Note that the LWQ2 and 3 are described where you made them in the Spar chapter, page 14-7

Plans 19‑5 step 4: When placing LWA2 & 3 on fresh bid pads after sheer web is wet, the metal tends to drift downhill. Instead, place them, drive two small holes on the downhill side (toward wing root) with a nail and use tooth picks pushed into foam below until protruding from sheer web only 1/8th inch to hold LWA2 & 3 against gravity slide.

Plans 19‑5 step 4: Rather than the plans through the wing tie downs, one builder suggests you mount the female parts of a press‑to‑release saber on bid pads on the sheer web in from the winglets so that the tie down hole only comes up through the bottom of the wing.

Plans 19‑5 step 5: Be sure to mask down several layers of newspapers along the spar before laying up. Wet the trough with pure, lay down the 3" wide UNI per plan, and pull out the twill thred that runs along one side of the UNI, then holding UNI in place carefully pull out all cross threds to make a much smoother and easier to wet out lay up. Some builders found that Safety II wets it out much quicker. Don't lay long UNI over shorter Uni. One builder suggests that when you lay up the spars you can get a flatter surface by overlaying peel ply, then saran, then 3" wide wood or foam and weights that won't fall over.

Plans 19‑6 step 6: When sanding the thick 3" wide UNI, wear full protection to avoid the itchy stuff. If you do skin while spar is wet, you won't be sanding at all.

Plans 19‑6 step 6: Make a 10 foot long sanding bar at least 1.5" wide out of a stiff object like box aluminum .125" thick. Use it to smooth all surfaces of your wing, moving the sanding bar on a 45o stroke while keeping the bar oriented just as the hot wire was oriented. (move it faster on the root end until parallel with spar, leading edge or trailing edge)

Plans 19‑6: Plans interp., on bottom skin‑note wing attach access is floxed before skinning. (see cross section BB Plans page 19‑12). See library item # on Aileron Construction made Easy ON86/8.

Plans 19‑8 step 10: When cutting ailerons from wings, scribe a line with a metal extrusion held in place, full length, then use scribe line to pull fine saw through the 2 thin plies of UNI. JJ85/4

Plans 19‑8 CS: See Nutting's Hinge Alignment article, Library Item # .

Plans 19‑8 last sentence: When notching for hinges, bevel the wing edge at the hinge for better fit.

Plans 19‑8 step 10: Don't even bother to lay glass into the aileron torque tube hole until you have finished trial fitting A10 and the universal joint.

Plans 19‑8 step 10: One builder suggests that even the best craftsmanship ends up with a tail heavy aileron. His remedy is to move the aileron hinge point (top of the wing only) aft .08". We tried it and it still needs some lead in the front.

Plans 19‑8 step 10: When trying to put bondo on hinge, one builder suggests you drill holes (matching the AN525 10R8s) in popsicle sticks, bolt them to the wing on one end and bondo(or spray Zap) them flat on the top of the aileron so that when you carefully remove the bolts, the hinge can be placed correctly against the inside of the aileron.

Plans 19‑9 step 10: Note the tube that projects out of the aileron is only 9" long and projects only 1"‑there is no drawing that shows its length in place. the 30" long tube goes through the area from wing root to aileron. Be sure to locate the A10 tube as near to the center of the aileron to obtain the full 200 aileron travel without interference of universal with wing skins. jj85/4 Several builders have blown this. Be sure the tube is collected up in the hinge rivets.

Plans 19‑9 step 10: To lay in steel rod in the leading edge of aileron, use a slightly undersized spherical dremel bit and finger grip set to the depth of the rod and develop round trough for rod. Taper off foam and micro. Be sure when you are done that the leading edge is as round as possible.

Plans 19‑9 step 10: When checking the balance of ailerons, tape the correct weights to see if your aileron is in range, but wait until finishing process to place the weights. One builder used plumbers lead wool for weights. JJ85/4

Plans 19‑9 step 10: ON83/3 To avoid wear on the standard aileron hinge pins, try a smaller pin ‑1/16" stainless steel welding rod‑with tight fitting teflon tube‑see newsletter. Kreidel was concerned about hinge pin fretting and has found a teflon tube which is 2/1000ths larger when slid over a smaller pin. The change costs $5.00 per plane. In Sq 2, H. Childers has bought a supply to sell. If you want to talk to a supplier: McMaster‑Carr 213‑692‑5911 in LA, 312‑833‑0300 in Chicago Part Number 5335K17 see also cp39 pg 7.

Plans 19‑9 step 11: Ron Schroeder has developed his own wing hole cutter which should be studied. It incorporates a 5/8" rear guide as well as the pilot.

Plans 19‑9 step 11: Cross‑section 0‑0 shows (2) AN4‑16A bolts with wrong nuts, you need (2) MS21042‑4s instead. JJ85/4

Plans 19‑9 step 11: #13/2 on installing a bearing on torque tube. A separate sheet is available from the librarian and tech. committee to see how Prout did it. (Library item #54D). Be sure the last thing you drill is the CS132L.

Plans 19‑9 step 11: Ron Schroeder, sq 2, has an even better plan using a 1 1/2" 2024T3 bar stock drilled nearly through (leave lip) to press fit 6‑SF‑10 Torrington bearing, outside is then milled to 1 1/4" with lip on the opposite end like a top hat with part of the lid cut out. Slide this into plywood piece with 2 ply bid on both sides instead of phenolic. Aerospace Bearing Co. Moorepark, Transport Dynamics #03824-10 or MS14102-10. 805-531-0001

Plans 19‑9 step 11: There is a two pager from CS Sp8716,17 on a retainer for the bearing. See Library Item #

Plans 19‑18 step 2: #5/2: ***Builder Hint***: Drilling wings into the center section spar, use a 5/8" diameter piloted spot‑facer made of high speed tool steel, available from industrial tool supply houses. This tool cuts better, faster, and truer than the 5/8" counterbore supplied with your kit.

Plans 19‑18 step 2: AS84/6 See drawing and method to be sure bushings are proper depth in wing and spar. One other builder suggests sticking the bushing from inside out to mark the correct point to cut it off.

Plans 19‑18 step 2: The San Diegans mention hooking up a vacuum hose to pilot holes when spot facing to cool and clean the cutting surface.

Plans 19‑18 step 2: Another builder suggests the holes can be drilled quite quickly by moving drill into cold water frequently (you are not quenching it‑ you are keeping it cool so that heat is not transferred.) He then moves from hole (cool) to hole to keep the blocks from getting hot. He also uses a unibit with a smaller diameter to get out whole gobs of metal quite cool, being dunked in water too‑but be sure you leave a litle of your pilot hole intact to do the next stage with the approved bits. The bushings are not press‑fit, they need room for flox.(?)

Plans 19‑18 step 2: One builder used a 3 fluke 5/8" reamer with 1/4" pilot purchased ($35‑50)at an industrial tool supply, after drilling the 1/4" pilot holes. It took 1 1/2 hours total, applied 2 minutes per hole to allow cooling. Second person used compressed air on hole while drilling‑this process is a considerable savings of time. The builder suggests slowing to 2 and 1/2 hours, cooling reamer in cool water.

Plans 19‑18 step 2: Dan Worley has a good reamer for loan, and thinks its great.

Plans 19‑18 step 2: One builder watched in Sweden as a simple drill, with an extension threaded into it, was used to cut the holes, the drill remained cool and the job took minutes instead of hours.

Plans 19‑18: jj86/5 Bob Hummel suggests that failure to note the number of washers on any one point can lead to problems. (I suggest you carefully note them in your builder's log‑with a drawing) Bob also suggests you put a small bead of silicon RTV around the edge to fix it to the attach point‑careful not to get some in between mating surfaces. If you want to write notes on fiberglass, use some liquid paper correction fluid (i.e. whiteout) to make a noteplace then use a fine point marker on it.

Plans 19‑18 step 2: The USArmy Long EZ folks found nut plates appropriate for the Wing attach. They mounted them in the spar by mounting a cut off bolt on the outside, twisting on a nut plate as a drill guide and drilled and placed rivets through the spar metal points. Rutan hasn't commented on this, are nut plates as strong as nuts for this application? AM86/12

Plans 19: JJ83/8: See two full pages of ideas on making a clean interface between spar and strake. This waits for strakes to be installed first however.

Plans 19: One suggestion on relocating a straight line in the finishing material at the spar/wing gap is to take a rod, like a 15" hinge pin, sharpen an end and use a drill and carefully push the pin up through the gap from the bottom (relative to the top side of the wing you are working on) up to the skin you want to cut. Then connect the dots you have just created with a straight line. This is to help you avoid cutting into the hard points.

Winglets on

CHAPTER 20: WINGLETS/RUDDERS

Plans 20‑1: Dave Ronneberg builds winglets with Comm antenna for $250 or with 2 Comm antennas or Comm & Loran antennas for $300‑ 213‑477‑5958. Didier Makowski is competative, 213‑397‑4110.

Plans 20‑1: #12/3 Don't put on winglets until the bottom of the wing is faired into the spar and if you can, finish the bottom of the wing, unless you have an urge to work on wings that are chest height with winglets on.

Plans 20‑1 step 1: Materials: There are a number of templates available from past builders. It is your responsibility to check that they conform to plans and updates, you are the builder of your aircraft. When cutting winglet foam, put the experienced hot wire man on the smaller end, and have the inexperienced one read the numbers.

Plans 20‑2 step 2: it is worth installing radio antenna and possibly a second or a loran in the opposite winglet, outer skin, note Loran pre‑amps must be located as close to the antenna as possible, people who mount in the winglet put in a little covered recess the size of the pre‑amp too, even if they haven't bought the Loran unit. Of course the recess matches only one pre‑amp on the market and pre‑amps and Lorans are not inter compatible.

Squadron 2 Library items:

Radio Systems Technologies prefab antennas, #57A Antenna Dynamics Brochure #57C.

Loran Antennas for Homebuilt Aircraft‑Avionics news, #27F.

Antennalets, Jim Weir on hidden antennas, Sport Av Jan81, #57D.

plans 20‑2: It is also worth doing the basic finish on the winglets before you attach them to the wing (except in the attach areas you peel plied before), because with the winglet on the end of the wing the sanding becomes much more ackward. Who knows if you should do the rudder area too, but the rudder plans seem to handle finished wings as well as new construction. JJ86/7.

Plans 20‑2 step 2: Stan Schneiderman is assisting RNAV in placing a Loran Antenna in the winglet. RNAV feels that being sure that the coax is equally split between the covered end and uncovered end is most important. Having the antenna as close to vertical is the next consideration. Stan's installation consists of a vertical line on the outside (flatter) surface of the winglet running vertically (not lined up with leading edge) from a point behind the reinforced UNI mounting. Measure in 17" from the Front bottom endge of the winglet and strip a RG62 cable at 26" and remove the outer cover from their up.

Plans 20‑2 step 2: FM87/2: It is easy to jig the winglets with Zap‑a‑Gap.

Plans 20‑2 step 2: Be sure to use the ply schedule called out, if you have any intention of shorting the plies, review RAF letter AS86/13,14.

Plans 20‑2 step 2: Instead of covering the lower winglet before mating, mate it first and then cover when properly installed.

Plans 20‑5: Dave Randall developed a way to bury the rudder bellcrank in to the wing end to avoid that unsightly cable and belcrank that sticks out of the wing, see author for second hand drawings, Randall has disappeared again. The same basic concept came up within the E‑Racer, although the E‑Racer's winglets' leading edges touch the wing leading edge unlike our bird.

Plans 20‑5: DJ85/3. One builder suggests that rudder cable to outboard .032 steel bellcrank is under constant tension and the cable thimble wears out in 200 hours. He suggests you use the same technique as used at the bellcrank at the firewall. This puts a spacer in hoop tension with the thimble. You can replace the spacer without replacing the whole rudder cable.

Plans 19 end: Gene Zabler has a simple gust lock which looks like two tubes forced through a .020 aluminum plate which is installed into the gap between wing and aileron. the upper and lower forward point on the plate has holes for cord that wraps around leading edge, and they install a remove before flight flag on the bottom. CSN Mar86.

CHAPTER 21: STRAKES/FUEL SYSTEM

Fill your tanks.... The FAA recently produced the most innane warning to Long EZ pilots I have ever seen. They warn that a Long EZ cannot be completely filled when the nose is down. That's true and obvious to any owner. Think about it, some fool flew for 45 or so gallons and claimed to the FAA that he thought he had 52? So, for the first 6 hours he did not register what he was using and more importantly, what he had left? Maybe he had those famous Rutan gas windows that cloud up. Paul Prout's partner and Vance Atkinson still making the crystal clear windows which is lightable. I would add the lights to avoid stiff neck crane syndrome. 714-621-0060

Wing Windows.... You really don't know how little ground you can see in the back seat when you don't have the little wing windows in the bottom of the strakes. If you want great praise from the usual back seater, fit this one. Suddenly the back seat becomes more comfortable for longer trips. But then, you want to cover up the glass with baggage.

Plans 21‑1: JJ85/17‑20 Cessna Part Number 138‑0311070‑L is a rebuildable Cessna 180‑182 fuel valve that can be modified for left/right use only. Used: $20‑120. New $389.

Plans 21‑1: If you ever add an extra tank to the Long EZ, talk to RAF or an experienced builder. The requirement is a 4 way valve and and extra vent. Each tank must have a seperate vent. AM85/6 Never install a "both" position valve.

**(From Chapter 14-1, above)**

Plans 14‑1 Most builders notice after they have installed strakes that the last 8" of the upper surface of the spar (with overlays) project 1/4" up or down into what would be the ideal surface of the wing/strake, this requires a lot of preferably bottom fill. If, when you build the spar, you could slope the last 8" of the spar somehow, while leaving the sparcap material and metal exactly per plan, it might make a better final result. Quite a few builders simply sand down the "non‑structural" parts of the spar forward end and reglass it.

Squadron 2 Library Items:

Orr PRC applications suggestions pachage #43A.

Auto Fuel, Questions and Answers, #43B. Prout on Auto Gas, #43C,JJ85/17‑20.

Prout on untested Fuel Guages, #43D. Eric Cobb, Hole in the Wall gaing has quickly jigged and built starkes from scratch. Photos on the jig, #43E.

Sardella's Fuel Low warning wiring system, #43F,#13/4.

Don't Fuel Around, Plane & Pilot, Feb86, #43G. Bad Gas, Pop Sci Mar86, #43H.

Fuels and their effect on Fuel Systems and Performance, Art Bianoni, CS News, Jun86/13, #43I. PRC1422, Their old standby compound, #43J.

3M Clad Fuel Resistant Coating No EC. 776 #43K. Mr. Funnel, filter brochure, #43L.

Make sure your tank will not accept the new Jet nozzles, (how to get no lift after takeoff). #43M.

Home‑made Quick Drains, #43N. Auto Gas problem Sheet, #43P.

For the latest in Autogas Research, Lt Plane Maint May87/12, Library Item #43S.

Plans 21: One builder suggests the best way to avoid holes in tanks is not to make them, not to use clecos to hold parts together.

Plans 21: Buzz Talbot, CS SP87/1, describes one forced landing caused by the cork gasket on the gascolator blocking 60% of the exit of the unit.

Plans 21: CS' Art Bianconi reports lots of AC Fuel pumps leaking. AC is reported out of this business. He suggests aircraft bolts replace the screws at the diaphram and safety wire the bolts patterns, top and bottom.

Plans 21: DJ87/4: Bruce Merryfield of San Diego has strake molds to rent for $10.00‑619‑744‑9469.

Plans 21: Steve Snyder has just begun trying the Sportflight strake leading edges and finds them a dream, then he sold his bird to hole‑in‑the‑wall member Pat Halverson. The instructions are clear, and our comparison with the other systems is that they are nearly as fast, and considerably cheaper than the Task ones.

Plans 21‑3 step 3: The author supplies the ultimate pachage on PRC tank liner, including purchasing, installing and all the related info. presently available for $5.00. Write: David Orr, 33812 Diana Dr. Dana Point, CA 92629 of note, PRC stopped producing this stuff in December 1986. Alex Becker (313)695‑0069 has talked to them since and says Bob Nelson of PRC is testing before returning to production by March of 1987. He also suggests a shelf life of about 6 mos. But there may be a new source of liner. The Sterling dealer claims to have a similar product. And 3M may have another. Wicks advertises Sloshing sealer #912 by Randolph which is impervious to alcohol and auto fuel: $11.65/Qt, $34.00/gal.

Plans 21‑3 step 3: DJ85/5: One ***Builder Hint***s not to mount the outboard ribs in your strakes until you are finished fitting and testing strakes for leaks. If you do, you can't reach in for top edge tapes on R45 or the fuel cell cover. Also of interest, 25 clecos to hold everything in place while fitting and bonding is ideal.

Plans 21‑3 step 3: Placing the leading edge drains can be accomplished by the following method. Many builders have had leaky drains over the years because they don't realize that the drain plugs/valves are pipe threads that actually taper. They cut the threads too deep for the plug/valve. They also use the RAF advised 1/8" metal which is too thin. Use 1/4" alum., drop the nose of the aircraft to approximate parking position, pour water into the bottom half of tank carefully and place the aluminum "level" with the water. Blow out enough water that the aluminum is just the lowest point in the strake in this position and then use a pencil to mark the water edge. Fill the space with bondo which holds onto sanded aluminum well, is fuel resistent and light enough for the purpose. Be sure the hole you drill in the aluminum is the lowest point in the tank to obtain all the water when you drain your tank. One builder suggests flush drain valves by Manufacturing Division Inc. Model 5391‑187 from Jeff Goldberg (SQ 2) for $10.60. AS85/8

Plans 21‑3 step 3: The strake slopes gently into the fuselage and you may have observed that some builders build little raised "heavy weather" edges (lips) along the fuselage edge to keep items in the baggage areas from falling into the cockpit. Be sure to add this part after placing your tapes from strake to fuselage as the joint is structural and should not be weakend by taking a detour over the lip you place in. In other words, add the lip afterwords.

**Plans 21‑3 step 3:** Maj. Kirkendale claims that at altitude he has a small fuel pressure drop when using Mogas instead of Avgas.

**Plans 21‑3 step 3:** There is no apparent distributer of PRC although their regular products are so close to the same specs that a little research needs to be done in the field to get the right stuff. Paul Prout and RAF don't feel they can distribute PRC tank lining material when PRC is placing a disclaimer on its use in homebuilt aircraft. For one aircraft the guess is that you need 1 pt primer, 1 qt black liner, 1 qt white liner per aircraft.

**Plans 21‑3 step 3**: Before you do heavy wet layups or glue the top of the strakes down, consider a urethane tank liner. The Harris plane now has a urethane tank liner manufactured by PRC which is applied without the heavy epoxy layup on TASK strakes. It should be lighter, and more rugged, check with them before you buy. Have several people help you apply the stuff in good ventilation. The MEK solvent bakes out and the stuff thickens before you could get it all on. #43A or DJ85/6 and AS84/3. Melville is hopeful the extra epoxy layups would be unnecessary.

**Plans 21‑3 step 3:** The Auto Fuel controversy continues, with RAF concerned that the apparently uncontrolled levels of Toluene resulting in a leaching of Epoxy from strakes with the resultant replacement of that vital part of the aircraft. The PRC would be a neat solution.

**Plans 21‑3 step 3:** Other options to PRC: You may simply do it according to plan. Furthermore there are other options available. Ronneberg, who has assisted a number of builders, is convinced a fine weave glass cloth (4oz) layed into the nearly completed strakes eliminates pin holes and gives strength to what is otherwise simply thick epoxy with no added strength. ON85/10

**Plans 21‑3 step 3:** A number of builders use 4 vent lines, 2 as per plan and 2 with one end about halfway out the spar and the other ends at the same place on the turtle deck.

**Plans 21‑3:** Several builders comment that using aluminum screen in the strakes is asking for trouble due to corrosion. They recommend you use brass screen. With all the "Head shops" gone‑where to get it is problematical.

**Plans 21‑3 :** AS86/6, Squadron 1's Steve Harmon has a sump blister mold. Didier Makowski at Santa Monica makes blisters 213‑397‑4110.

**Plans 21‑3 step 3:** Before you close your strakes up, you may consider what has been seen in Santa Monica recently, an 1/8" plexiglass window on the bottom of the baggage area (roughly a parallelogram with enough original strake around it to provide strength. The builder also placed a window adjacent to his front left elbow for the pilot. I have done the former and will use 2 ply uni around the window to replace the strenth removed. I have no idea if that is enough. ON85/10 Jan & Hans Van Noord are first builders to install them if you want to take a look at a set, visit their bird at Santa Monica Field.

**Plans 21‑3** When building the tanks, this is Mike's most frequent telephone call at RAF these days, use 2 cups of epoxy to slop the stuff all over the inside of the tank, fuselage and spar to prevent fuel leaks. In his many tanks he has never had a leak. He believes the best approach to finding a leak is to hire a good gas man with freon detector. Once a leak is detected, put a light vacuum on the tank(Unot with vacuum cleaner) and paint thin epoxy on the outward manifestation of the leak to let it get into the foam and to the inner leak.

**Plans 21‑3** With all the discussion of lightening, Morgan Dean has decided to electrically bond (connect) the vent lines, fuel caps to fuel cap fittings and a ground point. He believes that the chance of static discharge in the tank is reduced.

**Plans 21‑3 : step 4:** We are amused that 3 people have found their much sought leak in the altimeter itself. Take a hint if the pressure drops at the same speed on both tanks. Also, the leak, if you use a sniffer, may be several feet out in related structure. ON85/10

**Plans 21‑3 step 3**: On the strake windows, Jan & Hans Van Noord are first builders to install them if you want to take a look at a set, visit their bird at Santa Monica Field.

**Plans 21‑3 step 4:** #13/4 Larry Romanoski recommends a Fuel low level warning light and buzzer and a light for the fuel window.

**Plans 21‑3, step 4:** Jim Sardella has plans for a fuel low circuit for Prout's old guages, how to make Prout's old guages is the problem. See library item #43F. He sells the board for $10 and the parts can be had at Radio Shack for about $15. AM86/12

**Plans 21‑3 step 4:** Paul Prout has stopped selling fuel guages, but restarted in Spring 1986. AM86/3,12,JJ86/4 He has just started marketing a $30/pair version that seems very well designed, but without fuel low warning, 714‑621‑0060, FM87/2.

**Plans 21‑3 step 5:** ON84/3 On one method of fitting top to strakes, see discussion on using carpet tacks. What appears to be left out is that the ribs can be fitted from inside the cockpit quite precisely once the skins are clecoed together and the skins are in place. Ribs are pushed in and trimmed until they fit quite precisely. Less need of great globs of flox.

**Plans 21‑3:** Several builders comment that using aluminum screen in the strakes is asking for trouble due to corrosion. They recommend you use brass screen. With all the "Head shops" gone‑where to get it is problematical.

**Plans 21‑3:** Bob Davenport responds to this by suggesting if you can't get brass screen, contact McMaster‑Carr Co for .0159" thick perforated brass sheet which has 100 .065" dia holes per square inch which is 33% open. The price was recently $22.39/square foot which would handle 4‑6 planes. The Tel # is 213‑692‑5911 in LA and 312‑833‑0300 in Chicago. JJ86/6

**Plans 21‑3 step 5:** Bill Reid suggests that the TASK baffles are poorly made top and bottom. He advocates placing "silver tape" along the roof of the tank at the baffle edges, laying up 2" bid tapes on them (some cap strips), when 4 hours tacky, place the top back onto the baffles and weight. When cured, pull up the top and lay up some BID from baffle to cap strips for strength.

**Plans 21‑3** Mike Melville is of the opinion that Task may not have added the extra ply on all their strakes where the crew gets in and out. He says it takes 4 plies when you want to resist knee marks and suggests you simply add the extra ply and forget the extra pound of weight, if a good finish is important to you.

**Plans 21‑ step 5**: #11/2 Consider using Explosafe in your fuel tanks to inhibit explosions.

**Plans 21‑3:** Bill Reid discovered the Task strakes is designed around the Aviation Products Inc. Fuel Cap. Part #F401 ($28.95 ea) Call 805‑525‑3663. It is the right size to "reject" the new Jet Fuel Nozzles!

**Plans 21‑5:** There are numerous reports of builders who didn't safety their fuel caps and lost them into the prop. Clayton Kau also carries a piece of foam rubber around to take the caps when the nose is down and the gas man is tempted to scratch the tank tops. see also CS Ju86/2.

**Plans 21‑5**: One builder suggests mounting the electric fuel pump to a position opposite the gascolator so as to avoid vapor lock. JJ85/3

**Plans 21‑5:** For a discussion on exotic fuels by an old head, see Library Item #43I, Art Bianconi CS Ju86/13.

**Plans 21‑5:** Maj. Kirkendale (USArmy) says his fuel pump placed in the spar area of the firewall caused the Army Long to forced land with air in the line.

He would prefer having the fuel pump as close to the tank as possible. As this would require two pumps he compromised by moving it to the passenger floor over the landing brake cavity. He accesses the bottom of the pump through the landing brake cavity. Caution‑think of the passenger's feet, the Army flies a bunch of Avionics as passengers, and nobody kicks their fuel pump. AM86/12

**Plans 21‑5:** Don't just put any old fuel pump on there. Rumor has it that California Microwave put on a Cessna 210 boost pump into the system and on downwind switched on the pump and immediately flooded the engine with high boost. AM86/12

**Plans 21‑ step 9:** One builder spent months plugging mini‑holes because he left vacuum on overnight while laying up inside of tanks. He effectively drew holes into the inner liner.

**Plans 21‑?:** Instead of cutting right into your tanks for the fuel caps, Dave Ronneberg suggests you cut down and leave the lowest skin , prepare the foam and top layer, vacuum out the flakes and junk and then, with a razor blade, cut the last layer, which leaves only a little residue to be vacuumed out of the tank.

**Plans 21‑5** When drilling holes for the fuel valve, remember that the drill will go through tires if the nose gear is up at the time.

**Plans 21‑5 step 11:** May83/2 Don't use brass‑on‑brass valve‑get one with teflon so it doesn't tighten up. Latest information is that that doesn't solve it either so... The San Diegans suggest Teflon valve must be modified to remain "free" by disassembly and grinding away a portion of the spring to reduce the seating pressure that spring exerts‑grind a little and test. A Piper dealer has another spring for about 50cents.

**Plans 21‑5 step 11:** Kreidel is experimenting with an Aviation Lube that costs $125/lb. Sq. 1 people may still have a lb. to share. Melville was selling little daubs for a while too. It has worked well in the brass fitting so far.(Mar 1987).

**Plans 21‑5 step 11:** The plans appear to have no cross section plan for the valve plate, use the "above view" drawing and extend the metal (.062 2024 or equivalent) about 3/4" when cutting, then bend with a smooth radius‑a sharp radius breaks off then or later.

**Plans 21‑5:** The South African Long EZs are running one fuel line from the fuel selector down the left side of the fuselage to the left tank. The process shortens the line a little, and appears to give no problems to them.

**Plans 21‑5:** AS84/5: See a drawing of a neat way to mount fuel lines, primer and heat.

**Plans 21‑5:** One builder angles the right fuel line 450 (toward your 4:30 position) out through the rear fuselage and grinds the exposed section back to .4" even though the tube is on an angle‑this is easier to flatten to the inside of the fuselage. The left side angles 1800 from the right (toward your 10:30 position) so that the fuel line wraps around the back of the rear seat bulkhead (use BID to fix it to the seat above the access hole) then along the right side with the other 2 fuel lines (right tank and engine fuel lines). When gluing the lines down, use foam or wood jammed accross cockpit to press the lines against the right side near the bottom. Whatever else, don't kink the fuel lines.

**Plans 21‑5 step 11:** DJ85/3: One Builder suggests the plans mounting of the Gascolator is unsatisfactory. He suggests we buy a $7.00 Gascolator mount from Aircraft Spruce to avoid vibration problems on the flared tube. He doesn't know what to suggest if you have already cut out the big oval in your plywood firewall per plans. It is hard to mount the fuel pump on aluminum sheet riding .25" from any other structure.

**Plans 21‑8:** #13/6 To avoid vapor lock and airstart problems, locate your boost pump below the high point of the system.

**Plans 18‑2:** Now you could do the wing/strake gap, but its better to wait for the cowls to be on first. See JJ84/3,4 or Ronneberg Cowl video, #63E.

**Plans 21‑8:** Two VARIEZE builders found their tanks "mushy" after 5 years in autofuel and the old epoxy‑Gary Hornbeck is replacing his tanks now.Plans 21‑8: If your Brock fuel caps leak, CS's Jamison suggests that you drill a hole in the dzus fastener and put a small "O"ring uinder a washer in the hole drilled. CS Ju86/6.

**CHAPTER 22: ELECTRICAL SYSTEM**

A simple cigarette lighter socket.... For auto type accessories, like trouble lights, portable vacuum cleaners, cassette tape recorders or disk players, portable electric tire pumps, even recharging the battery without opening up the nose, put it in a quiet place on the head rest.

Plans 22‑0

TIME TO GET PAPERWORK IN

See AS83/3 on FAA Advisory Circular No. 20‑27C dated April 1, 1983.

SQuadron 2 Library Items:

FAA handouts, 11A. LICENSED TO LAUNCH, Kitplanes, #11B.

How to Get your Homebuilt Certified without Hassle, Sportplane, #11C.

Author's list For the value of buying a wreck, instead of new, #16.

Contact author for Oklahoma service that rushes paperwork through FAA.

The process has changed again since the above publications. Now a paid EAA designee does the inspecting. He/she is likely to want to see a photo history, receipts as needed and the above ideas are important.

#11/3 See FAA procedures on registration procedure which takes up to 60 days.

Don't forget that when you register you must also register the Aircraft as a radio station. Call the locall FCC.

**14volt or 28volt?**

Of interest, Mike Melville, who runs a 28 volt system, feels that the weight savings is important, the reliability of starting is good, the step‑down for odd 14 volt items is easily done and the cost of 28 volt avionics has actually reversed lately all are convincing evidence of the need to go to the newer 28 qvolt system.

CS: For another warning not to mix 14 volt and 28 volt systems, See Anie Ash's comments including a recommended fuse box in the DEC86 Central States Newsletter.

**Wiring, Connectors & Switches**

Wiring....I used the very clear wiring plans of a Tomahawk and tried to keep wiring modifications to a minimum because I gutted a Tomahawk instrument panel, engine compartment and wheels and brakes (total for all $2200). I have the delusion that a good Piper dealer can fix my plane wiring quicker. I used aluminum conduit as the ground system from fore to aft. I wouldn't waste time burying conduit in the bottom foam as I did, due to the extra effort, or in the sides as I have seen it done. It is better just to use slightly heavier cable for fore-aft ground and not use the aluminum. The mating of aluminum and copper cable presented some real corrosive problems.

Dave Ronneberg has wired about 5 Longs. He has evolved the following: 1. He particularly likes Rusty Fosters plans which are the only full schematic for wiring. Library item #30. DR uses 14 pole terminal blocks set up on both sides of the fuselage, fore and aft. He recently used one 5/8" aluminum tube with a braded ground strap at each end (cut open, slid over and clamped with a stainless clamp) in conjunction with a ground wire served as ground for a starter equiped bird. He suggests master breakers and Rusty advocates the remote breaker. He cautions that strobe bulbs cost $108 so try not to reverse wiring on them. JJ85/3

Sq 1's Bob Brown is a wiring genius, 714‑525‑8032

This is a good time to visit the local aircraft factories for scrap stuff.

AM84/3 See Kreidel hint on using molex molded nylon electrical connectors as a substitute for terminal blocks or point to point wiring.

Squadron 2 Library Items:

Wire Installation Practices #39A. Useful Electrical Wiring Details #39B.

Electrical Hints from Orrico & Romanowski, #39C. Switches & Such I‑III #39E‑G.

A Switch is A Switch‑Or is it?‑Central States #39K, CCMar8b/9, shorter version AS86/11. Sardell on Overvolt relay #39I.

Bauer, nose gear down switch mount drawing, #39P, AM87/15,16.

Bianconi on Long EZ Wiring #39J, CCMar86/14‑17. Wire Selection Chart #39N, DJ87/9,10.

Ronneberg has a nice breaker panel in the location of the space saver. He found it infinately easier to wire all switches and breakers from panel forward to a block on right fuselage side, thence to particular electrical item rather than stringing from instrument panel back, one item at a time.

Terry Dazey, Seattle, instead of the usual "Space Saver" for switches, has bent his space saver panel around into the leading edge of the strake. AM86/13

One homebuilders article suggests that even if you don't want to buy a whole bunch of colored #18 wire for your bird, you should at least use a black for ground, standard throughout for ease of understanding during construction and repairs.

Apex Wire, 8909 San Fernando Rd. south of Lankershim, near Whiteman field, has a large assortment of salvage stuff at very reasonable prices. 818‑875‑1308 AM86/14

AS85/3 The Kreidels suggest new GM light weight fuses and fuse blocks instead of the heavier plan breakers. You will have to carry extra fuses though.

#13/4 Consider a (pilot by‑passible) rear seat engine "cut‑off" switch so the rear seater can land if pilot incapacitated.

#13/4 Consider an electrical access plug in nose for jump starting option.

#13/5 See schematic on circuit for starter/lighting etc.

#13/6 Locate stud blocks on forward side of the firewall? It is neater, accessible from the bottom panel or the rear seat hole.

#13/6 To avoid cranking the engine with radios left on, place a radio master switch in the circuit.

#13/4 Consider paneling major assemblies and constructing an out of aircraft master wire harness system.

#12/2,13/4 Consider shielding signal wires nose to tail.

#13/6 Don't use shield from shielded wire to carry current.

#13/4 Run shield cable for mag switches and use mag filters to avoid radio (etc) problems.

#12/2 When splicing wires if you must splice, be sure to solder.

#8/4: Alternator Circuit Breaker to match the maximum output of your alternator should be installed in the #10 wire from alternator in Type II system.

Dusty Rhodes emphasizes that audio signals should be kept away from battery wires, all audio wiring should be shielded. Dusty is very good at designing Radio/Instrument packages. AS85/8

***Builder Hint***: It is better to run ground wires back to single ground point on alternator for any instrument that measures anything. The ground on the instrument panel is ok to do lights etc.

Flashlight.... Put a minilight flashlight holder into the strake leading edge, focused on the panel. The holder makes the flashlight always available in pre-flight and flight and provides a good position if the electrical system goes out at night.

#10/2 Certain Bendix Ignition switches should be replaced, see details.

Two builders use two general wiring methods, one keeps track of wires by using duplicate terminal blocks fore and aft for ease of problem solving. Another advocates direct wiring with careful planning of the loom before any wire is made, and careful labeling at each end.

For wire, try Wire Mechanics of Valencia‑5086 type 2 is cheaper than Aircraft Spruce type 1.

**Fuses & Circuit Breakers:**

Bob Brown reports he now has terminal blocks for "GM" fuses‑they should be mounted on plate behind surface of instrument panel so that only the fuses are exposed. He is building in 5 dummy positions for spare fuses. Mike of Bedford Electronics, Addison, Illinois will sell you any amount‑call 312‑865‑2400. AM86/4 Bob calculates the whole fuse panel should cost around $31. AM86/17 Holders: P/N 155320 U, 14 gage/20 am at $.79 each (they snap together.JJ86/3

JJ86/5 Arnie Ash adds: The fuse block unit from a wrecked Datsun Maxima is usefull for these fuses, it is 8 1/2" long 2" wide, 2" deep and contain 15 fuse positions. This in combination with 5 spst and 4 dpdt mill spec micro switches and a Master Switch nets Arnie a space saver panel 12" x 3" x 2 1/2" The Datsun unit has wires grouped to several 4 unit buses which allows a mixing of 12 and 24 volt systems. See the brochure: JJ86/12

There is a recall on Mech Prod Inc circuit breaker model 4001, 4200, 4310 and 8500 mfg after 1984. If in this category, check AM87/9 or Library item #39M.

CS Sp87/4 1987 Ford trucks have a spare fuse holder for 5 fuses, per Ken Humphries 816‑453‑2144.

**Intercoms & Headsets**

Materials Committee: There are a number of people in SQ1 with experience with intercoms, talk to a committee member.

Library Items 20A through G on intercoms of all type.

***Builder Hint***: Jim Striedel is working with Syntronics intercom

Sigtronics Don Sieger is the contact at 818‑915‑1993. The units work with cassett players, in Sterio.

Squadron 2 Library:

In Search of a Torture Free Headset (Forget walkman headsets) Av Consumer #20A.

Converting Sterio Headphones for use Aboard Aircraft, PRIV Pilot Aug86, #20B

Communication is key, Priv Pilot83, #20C. Sigtronics Brochures #20D.

David Clark Brochures #20E, Soft‑Comm Brochures, 20F.

Oregon Avionics brochures, #20G. Telex Headset Brochures #20H.

Davtron Intercom Brochure, #20I.

**Space Saver**

Stan Schneiderman has received a Rusty Foster panel for under $600. He says Rusty's product saves so much time and is so nicely thought out that you should consider it, wired, unwired, with all parts or with your own specifications.

Rusty Foster's schematic is great for $25.00 plus shipping and tax. There are a lot of testimonials out there! Rusty's latest version ON86/17,18, photos DJ87/4,21,22 (see library items 30A‑D)

CS's Jamison tried LEDs above every switch and now thinks it is a waste of time. CS Ju86/6.

**Instruments**

Watch out if your tach hooks up to your mags. CS reports a loss of 400 rpm due to the connection. Pat Saffron gives a little discussion. He thinks his options are that or a mechanical tach. The answer is a remote sensor, like Javelins.

See Tom Howard's cheap way to buy avionics with a used Tomahawk in engine chapter.

The author has built a small library of Instrument panel documents for the person at that stage. It is a check out and return item only. Please contact author when you are ready to read up on panel and return. Copy if for educational purposes at will. 213‑472‑5975.

Squadron 2 Library Items:

Dry Vacuum Pumps, #22A. Precise Flight‑Standby Vacuum system, #22B.

Avoid Gyro Geriatrics, using, buying & overhauling, #23A.

Gyro Instrument System, #23B. How to Troubleshoot Gyro Instruments, #23C.

Homemade Ammeters & Voltmeters $39D.

Maintaining wet compass, #47E. How to Keep a Wet Compass Wet, #47F, Lt Plane Maint May87/10. Instrument Hole Cutter, Sport Av, #26B, May83/25.

Tachometer Repair for the Beginner, #47A.

Drawings Specs and Installation of B & D Electronic Tach, #47B. Source?: Sports Flight ‑ get catalogue 904‑796‑1874.

Javelin Tachometer Brochure #47C.

New engine Monitoring systems brochures: #52A‑E.

The unreliable WestTach is no longer produced by that company. The Carr tach is a remote tach that works. The better option is probably the Javelin Tach for just over $100. JJ85/3.

***Builder Hint*s:** use a thinner walled 5/8" aluminum tubing (.015 to .020) on vacuum lines. Anything less than 5/8" is too small for distance to the front of the aircraft.

#10/1 Manifold Pressure guage is a good idea.

One article suggests the use of star lock washers should be complimented with a dab of nail polish so that loose screw connections can be spotted quickly. AM86/14

The J.C. Whitney catalogue offers ($30?) a clock, timer, temperature sensor which is worth considering. It is about the size of two packs of gum. The ad seems to indicate inside and outside temp which has a warning buzzer when the temp goes to whatever temp up or down you select. There is only one lead and only one probe to read temperature inside or outside. We are hoping someone can diagnose where to take a lead off to drive a circuit to turn on an avionics cooling fan for those hot days on the ramp. JJ86/7.

CS's Jamison says he has had pitot heat, and he wouldn't bother with it as it takes too much power and is of little use. CS Ju86/9. He also lists the good and bad: Small Westach oil pres/temp is good. Westach tach not accurate. Westach spark plug thermocouple(s) (#4 if only one cyl) and CHT ok. Westach EGT not useful, engine runs rough before peak EGT arrives. Westach fuel pressure sender useless above 2200 rpm due to vibration, he relocated it sucessfully. CS Ju86/11.

Wicks now carries EMS 2 1/4" non tso'd tach, hours, oil 7 H20 temps, OAT, EGT, CHT, vacuum, fuel level, voltmeter, ammeter, clock, oil fuel and air pressure guages.

**Lighting:**

#5/8 Vearl Taylor supplies strobes.

***Builder Hint***: LEDs are available with higher output for lighting instruments.

#5/7: Builder add: A plan for a panel light dimmer switch using Radio Shack parts.

***Builder Hint***: Jim Striedel is working with Syntronics intercom and a 400 candlepower strobe.

Post lights usually cost from $12‑15 new. National Aircraft Salvage has them for $7.50. They may have no bulbs or 24 volt bulbs. Bulbs unlimited sell the little bulbs at about $1.00 each.

For an interesting "back lighting" discussion see Library item 26E, Spt Av May86/33.

Layout:

We have a squadron 2 Instrument layout book with photos, ideas, construction techniques and wiring ideas for rent by the week. Contact D. Orr‑ 949-248-5727.

Squadron 2 Library items:

Instrument Panel Layout, #26A. The "Basic T" for good instrument flight #26D.

Inst. Panel & Cockpit Design Nov85 Sport Av. (.10) #26C.

#13/6 Locate Hobbs off the Instrument panel‑you don't need to refer to it in flight.

AS84/7 for drawing of Kreidel Instrument Panel.

#10/1 Dick Rutan recommends direct reading guages where possible because the electrical senders are sensitive to wiring bundle current, R.F., E.M.F., etc.

For hole planning and cutting, use an "Instrument Quick" available from Aircraft Spruce, and punch out 5 holes before cutting the large instrument hole. JJ85/4

CS's Jamison prefers: top row: Airspeed, Horizontal Gyro, Altimeter, Bottom row: Navication CDI, Heading Gyro, Vertical Speed.

**Alternators, Starters, Regulators and Batteries:**

Squadron 2 Library items:

Charge Up Your BATTERY Saavy, #65A.

Minimizing your Battery Problems‑Sport Av. Jan 87. #65B.

Causes of Early Battery Death Light Plane Maint, #65C.AM87/7

Smart/Charge brochure, #65D CS SP87/5,6.

Per Light Plane Maint Aug87/16: You can long charge a car battery but not an aircraft battery because Aircraft battery plates are small and few in number

and even if the things don't overheat they warp or shed spall. This does not mean a solar array of a few square feet would not work. They suggest "The Maintainer by Solar Engineering, Inc. which give 50 to 70 milliamps at 15 to 20 volts $49.95 from Northeastern Aviation, 70 Airport Rd. Westerly RI 02891 1‑800‑633‑4411.

Honda and Bosch ALTERNATORS modified by Pelican Aviation, #58A. JJ86/11

**Alternator Troubleshooting:**

A pilot's Guide, Lt Plane Maint #58B.

Tim Lally evaluation of alternators by weight, output and serviceability, #58C, AM86/17, JJ13‑15.

Sardella's drawing on Overvolt relay system,JJ86/18, #39G.

How To Service Bendix Starters, DJ86/18.

Lycoming has published a Service Instruction on identifying correct ring gear for a particular starter on all direct drive engines, #35A.

Pelican Aviation knows Gel Cell Batteries quite well, give a call if you intend to use these beauties. For example, they must be charged at exactly 14.6 volts‑regulators must be precisely set.

#8/7: See details on an electrical supplier of alternator systems.

B & C Brochure on linear regulator, alternator and Starter #58D, ON86/3,5,6.

B & C Specialty Products, 518 Sunnyside Ct. Newton Kansas 67114 316‑283‑8662 has a new starter, long in the developing, it weighs 10.2 lbs instead of the standard 18lbs.

The standard Lyc/Prestolite Alternator bracket can be shortened by cutting off 3/4" of engine end of the bracket(non‑slot end) and then use a Gates 36 1/2" 3/8" wide belt. The alternator is swung all the wy in to get belt on. Reduces the size of the bubble necessary on cowl.

CS' Drybread likes the 10 lb/55 amp Dodge Colt alternator with internal fan and regulator.

For discussion on Voltage Regulators, See DJ86/17.

So many people run their battery down, why not a circuit that hits the buzzer as you walk away from the craft with master on. The trigger is zero oil pressure, with 5 minute defeat.

CS's Jamison believes he put on a regular size alternator just because of the load of the pitot heat and electric heater. The heater doesn't do well and the pitot heat is nearly unused‑he would drop them and the heavy alternator. CS Ju86/10.

**Avionics**

Radio Master.... I have had a radio master from the beginning. It saves starting surges, battery charge surges, jumper cable zaps, etc from reaching the radios.

Uncle continues to require transponder above 12500'and terminal control areas except Group II. On Dec 1, 1987 Altitude Reporting equipment will be required in Group II TCAs. Mode S will phase in slowly, based on manufacture of the modes S transponders. All new aircraft built after Jan 1, 1992 with a transponder will require this alt. reporting Mode S.

SQuadron 2 Library items:

Common Sense can Reduce Avionics Maint #37A. How Much Avionics to Buy #37B.

Navcom knowhow, #37C. Specs on NARCO Centerline II NAV/COM, #37D.

Terra Brochures, #37E. Communications Specialist Brochures #37F.

King Brochures, #37G. King Article on Retrofitting Radios considerations #37H.

ADF in the 80s, Plane & Pilot, #37I. Sigma Tek's HSI, Plane & PIlot Mar86 #37K.

Equiping Your Aircraft (philosophy & Suppliers), Flying, #37J.

King price list‑call 913‑782‑0400 for latest #37L. Michel Avionics Brochure #37M.

Avionics Troubleshooting Part I, Light Pl Maint Nov86. #37P.

Panel Mounting Communications Specialist 720, Plane & Pilot Feb87 #37O, AM87/11.

Basic Intro to HSI #47G.

One builders article suggests your starter switch sould automatically cut off your avionics, so you don't oversurge your radios etc. AM86/14

Be sure your various computers are wired in with the avionics master so that you don't oversurge them. One builder near completion put a low battery in series with his battery charger with smelly results in at least 3 expensive computer boxes. AM8614

One article suggests the biggest killer of avionics is the hot start up after sitting on the ramp in the sun. It suggests a peanut fan located behind the avionics be kicked on for 5 minutes before hitting the radio master. (Apex has one 12volt for $12.50. AM86/14

When looking for radios, Central States members are given special prices by Varga Enterprises Inc, 19920 South 124th, Chandler AZ 85224 (609) 963‑6936.CSN Mar86.

There is an Airworthiness Directive on Airborne Dry Air Vacuum Pumps available from Sep 1 1985 forward only. See Library item 47D.

Don't forget that if you intend to be more than 50 miles from home you need an ELT.

CS's Jamison gives the following ideas: Radios on the left, but inside the trim cables, perhaps slightly angled; 1/2" alum angle on sides and rear strap.

Low budget: Apollo I Loran C, RST NAV/COM w/electronic CDI, Transponder, RST intercom. Good capability: Apollo I Loran C, Narco Mk12D w/ standard CDI, Narco AT 150 Transponder, RSt, Marker Beacon. Serious IFR: Substitute IDME for standard CDI, Backup handheld which can be pluged into intercom.

On ELT Battery Replacement Tips, Library Item #65F, Lt Plane Maint. May87/7.

**Antennas**

For articles on Loran Antennas see Loran section below.

Sq. 2 now has two RST videotapes on Antennas, For plastic planes, VOR etc.

#11/2 See reference Chapter 3 above on Antenna Book.

ON86/10, Phil Mancini has a "Antennas" on technical specs and "General Aviation Antennas".

Squadron 2 Library items:

Radio Systems Technology Handout, #57A. Antenna Dynamics Brochure, #57C.

Antennalets‑ Jim Weir on hidden antennas, Sport Av Jan81, #57D.

Spraylat Brochure on Copper Conductive Coating "599", #57E, AM87/17.

RST has now shipped at least one marker beacon antenna with only 50" of copper film. The job requires 69" of film.

Larry Brown of Antenna Dynamics (213‑534‑1090 x22) offers to answer all reasonable calls on antenna questions. He lectured SQ 2 and SQ 1 on all the following:

He sells an antenna for VOR/Glideslope for about $80. He says that all comm and nav antennas should give a range of over 100nm. To install this one, it should be parallel to your canard, horizontal and as it is copper film with a small black box attached, it should be buried under at least one layer of glass. It is measured to be a 1/2 wave di‑pole. The electronics "tunes" the antenna to the ranges on both sides of the 1/2 wave size. A splitter can be used to attach a glide slope receiver too, without loosing too much power. Do not lay any of these antennas over used or unused antennas nearby. While a T & C connector is the best one for this type of work, the B & C connector is more common and the antenna is set up to accept one. Do not install another antenna in the same range on a fraction of a wave length away from this one or it will block your signal. Larry calculates the forbidden distance as prohibiting parallel installation closer than 13" to the first or on any location at 26", 52" or 104" etc away from the first.

He sells a $70.00 antenna for the marker beacon too. It is 66" long and is installed horizontally parallel to longerons. He is adamant that you do not install it parallel to winglet or canard.

Larry also sells his AD3 model Loran antenna for the winglet. It is essential that you install the pre‑amp as close to it as possible. Do not install it near to any other antenna, and do not install the cable to it near a power lead of any type. His is on flexible fiberglass material and can be installed on the curve of the main gear although an empty winglet is better. (Then shield the strobe power wire in aluminum, he says). You do not need a ground plane as the antenna has its own. He sells a shorter version which is not as capable. Do not install comm antennas closer than 13" in parallel (as vertical as possible) and do not install them on partial wave distances of 23.62", 47.25", or 94.5" apart. Additionally, you should consider putting in the pre‑amp even if you do not yet want to pop for a Loran. Be sure, however that the pre‑amp is the same brand as the Loran. The industry is not compatable.

Larry also sells a Com antenna ($80) which can be split using a splitter which unfortunately cuts the transmission and reception power by about 30%. He recommends rather that you use two antennas instead. For $220 you could install a duplexer which only reduces the draw by about 3%. Brown believes the Antenna Specialist type comm antenna, or any with ferrite beads used for transmissions, loses its power when the beads heat up during repeated use in a short period of time. When they cool down, they go back to normal.

Dipole transponder/DME antennas are very expensive so Larry sells a monopole which is a simple short rod with a ball on the end which must be installed in a ground plane of, hopefully, 3' in diameter (round is best) with the antenna pointing down from the absolute center of the ground plane which could be the thinnest aluminum you can find, or even smooth aluminum foil. It could be sticking down into foam or out of the bottom of a wing area. A less satisfactory area, if you round the corners a little would be to install in the center of the speed brake. The other transponder or DME antenna cannot be installed at 2.5", 5.0" or 10" distance. With a three foot ground plane, this would be impossible anyway.

For an article on how bad our simple antennas are and how to make a better one, CS' Bill Butters has written in CS Sep86/9, Library Item #57E.

Maj. Kirkendale (USArmy EZ) says his transponder antenna location in the forward fuselage was not read by radar when he flew away from the radar disks. The army moved theirs to the strake tip which solves that. AM86/12 Larry Brown says that you are safer from radiation if you are above the reflector rather than having it out to the side of you.

JJ86/4 Sam Kreidel suggests you locate your transponder antenna up front of the rudder pedals. Make sure the antenna protrudes through the bottom of the fuselage skin as much as possible. Furthermore, the antenna ground plane should be as large as you can fit into the floor area itself as low as possible. Sam built a fairing over the protruding antenna and developed interference either from the RTV bonding it in place or gray primer under the Imeron finish. Reception improved with the removeal of the fairing. The same question to Larry Brown suggested as round and as large a sheet of .063 6061 under the pilot's seat. The ground plane reflects the microwave down and away from you. Placing it any higher allows it to be shadowed by the things around, particularly the engine. The strake would be second best because you are parallel to it and have no protection from it. Placing it on the air brake results in tilting your protection away when you deploy the air brake.

Mike Melville feels the size of the transponder ground plane needs only be a radius equal to the antenna post height plus 5%. He suggests that the post be completely outside the skin.

**Loran**

CS' Drybread has success running his loran antenna down his relief tube on the left gear leg.

CS' Jamison tried and abandoned a SRD Labs L‑Nav 25. He istalled copper tube for ground, B & C linear regulator for interference free operation. He shielded Tach, Ignition wires Fuel Pump, Strobe Lights, and Alternator. He tested three0 antennas: A copper wire in winglet, a Coax (1/2 stripped) in winglet and copper wire on canopy. He says they all did ok but latter is easiest to work with. A Loran filter proved to cause no change. All Metal was bonded, no change, it all corroded so he removed it. Ground network in wing construction, no change. A MAR 70A (Marine Technology) filter was installed on the alternator and the signal improved significantly. Both units didn't work in manuevers so Appollo I was installed and was good. With Loran, DME becomes less important, except IFR.

Ferde Grofe, at Santa Monica, is final testing the installation of an ELCO Loran 921 Autofix and can assist in getting discounts on it. His antenna runs down the center of the canopy with the remote buried right at the canopy edge, the installation appears to be interference free.

Mike Melville is now convinced that the best way to get rid of problems with Loran is to connect up the Battery ground, loran tray, pre‑amp and ground plane with a seperate ground wire. He says to apply the silicone connector lubricant too.

IVHC28/1: Don Shupe reports that an auto windshield tape antenna, available at auto parts stores , run up the middle of the canopy and attached to the pre‑amp as closely as possible worked fine on Loran.

ON83/2 see suggestions on Loran C antenna installation retroactively.

Squadron 2 Library Articles:

AM84/7 Loran Antennas for Plastic Airplanes, #27A.

Aviation Consumer article on Loran: #27B.

Apollo Handouts: #27C.

Morrow Avenger Handouts: #27D.

May83/31: Brochure on MLX Loran‑C. #27E.

Loran for Homebuilts: Avionics News #27F.

Electrical bonding of Aircraft #27G.

Article on Nelco Autofix #27H.

ARNAV brochures, #27I, DJ86/19.

#26C; Inst. Panel & Cockpit Design Nov85 Sport Av. (.10)

#27N, Flightmate (navcomputer) brochure (.05)

#27Q: Plain Talking Loran (Compares Northstar Mi ($4K), ARNAV 21 ($4K) and Appollo ($3K).

#27P, Flying with Loran C Easy, Priv. Pilot Jul84

Loran Leads the Way, Acro mag, #27J.

Legalizing your Loran, #27K.

Tricks with Loran, #27L.

Finding LAT/LON, #27M.

Loran Interface, Plane & Pilot Apr 86 #27R.

More on Loran for Homebuilts SportAv Nov83 #27S.

Latest in Loran, Plane & Pilot Sep 86 #27T.

Northstar Loran brochure #27U.

Narco Loran brochure #27V.

STS Loran‑C 110 (Cheapie) Plane & Pilot Mar86 #27W.AM87/10.

Your can get pre‑amplifier and antenna installed even if you put off the cost of buying the Loran until later.

**Engine Monitors:**

The F‑Tech engine monitor is apparently defunct. Glen Nunnely seems to have pulled up roots.

Library Item #47C: Javelin Digitron Instruments brochure.

Shupes are testing a $6 Sears smoke and temperature detector with remote buzzer on firewall.

For Heaters, even electrical, see Engine section Chapter 23: "HEATERS".

**ENGINE only**

**CHAPTER 23: ENGINE INSTALLATION (and Section IIC and IIL.)**

**Chapter 23‑1**

**Engines**

Lycoming has released an emergency AD Lyc0‑235‑AD80‑25‑02 concerning 1976 to 1979 pushrods. The things flake leaving a tell‑tale yellow tip and flakes of chrome in the oil.

Lyc O‑235‑L2C there have been some disintigration of the intake lobe on the camshaft on a few aircraft at 1400 hrs. This caused a rough running engine.

Because many engines are missed by club members, we have started an Engine Network. Get on it and those on it that see an engine they don't want can pass the information on to those who do. Contact David Orr. 949-248-5725. Library Item #8.

FM87/9:Another source of 0‑235s is Boone Aviation 818‑845‑3595 and Empire Aviation, 1105 E 3rd St. La Junta, Colorado 81050

Tom Howard has just completed step 2 of his most economic way of outfitting a Long EZ. He has just completed about 18 months of flying in a Tomahawk, last month he stripped it and this month he is installing a vast list of parts in his Long EZ. (Call author for parts list of useable items.) He purchased the Tomahawk for under $6,000 and is selling the very useable skin for around $1500. The Tomahawk has enough maintenance Catch 22s that it can be a very desireable alternative to buying everything one at a time. Everything is 12 volt, everything fits everything else and you really don't have a price list of all the items you want to install in your bird until you have spent it all. The author used a wrecked one he purchased for under $3000. More potential headaches. There are flying Tomahawks around for under $9000 and under 1000 hours on the L2Cs.

Mississippi Aircraft Sales, 601‑475‑2582 apparently is an O‑235L2C specialist. Their prices are $3000 for a 2000 hour core, $3500 for under 2000 hours and about $7000 for a zero timed one. Each core comes with starter, alternator, mags, harness and carb.

FM87/12: A good parts distributor is Superior Air Parts 1905 E. 19th St. Signal Hill 90806 800‑237‑0422.

Don Douglas of Squadron 2 has thoroughly explored new engine purchases, Lycs only. Contact him if you want a new or factory reconditioned engine. 818‑783‑3729.

Dan Mason has purchased a rebuilt 0‑320 from Chuck's Aircraft, 670 Airport Ave. San Carlos CA 415‑593‑8403 He paid $9200 for a fully set up 0‑timed engine. The shop, he says, is immaculate.

Dick Kreidel has maintained a full set of Change Notices from Lycoming. You are the manufacturer of your aircraft, don't expect RAF to keep you up to date on engine component problems. JJ86/4 these are maintained at Sq 1's expense.

Ron Schoeder reports there is a new Lyc. Service Bulletin on the Thermostatic Oil Valve. An internal nut comes out and may grind the gear case up and kill the engine. Check your engine for this mandatory change, which involves removing the valve, cleaning the threads and locktight 290ing the nut.

Sq2 Library item #35 is set of Lycoming handouts and materials. According to the reference in the "owners manual" to using any accessory case on an 0‑235, you can bolt an 0‑320 case on an 0‑235 physically, but the oil passages are quite different and only the bolts are the same.

CS Jun86/1 If you get a non fuel pump 0‑235 engine, Wag Aero in Lyons Wis will make the accessory case modification to take an AC Fuel pump.

There is a skunk works in Arizona (Kreidel has details) working on a slimmer exhaust, oil sump and oil cooler which results in a closer cowled engine with smoother lines. The results are not in yet.

On engine choice, the Kreidels, have documented their change over from 0‑235 to 0‑320D3G. The change to 160hp gives cruise of about 14 to 16 knots higher, clime out at 3000'/min instead of 1400‑1500'/min, adds 46lbs weight overall and consumes a lot more gas, causes over‑cooling on descents. Dick wouldn't do it if presented the choice again. See their full article in FM86/5‑9. Library Item #32H. Of interest, CS' Herb Sanders (CS Sep86/2) discusses the Kreidel article as being way too pessimistic and draws the conclusion that Dick will not go back to a smaller engine. His own D3G weighs 10 lbs less.

There is an article on 0‑235 engine cylinder and 0‑320 valve mods for 0‑235 engines, and compression testing. See Library Item #32E. of note, one local engine man says the conversion is not legal(?) and converts from the sodium valve that is intended to fight cooling problems. Is it worth the time and cost? FM87/13

Joe Wright rebuilds C152 engines.

***Builder Hint***: The engine you get should have an integral fuel pump and Slick mags.

Before installing engine have everything from mags (already timed) to exhaust installed. JJ85/3

We were getting the manpower ready to lift an engine onto the engine mount for the first time (without an overhead jack, come‑a‑long etc.) when we discovered that leaving the engine sitting on a stand about three feet high, in our case a Work Mate, with the prop flange down 15o and simply having one person lift the nose of the aircraft to match the engine was such an easy process that it bears trying if you need to remove and replace engines without engine jacks. The aircraft is close to balanced at that stage and is much easier to tilt back to the engine, than lifting the engine up and down. JJ86/7.

The oil filler neck on many used and new engines is too tall for the Long EZ cowl. You may simply remove it, note how long the dip stick is, in relation to it and shorten it, bonding in a sleeve of PVC. You then remove the dipstick from the cap, shorten the top of the dip stick exactly as much as you have shortened the filler tube and repin the dip stick in the filler cap. The filler neck is very official looking but is actually made out of plastic. What we discovered the other day is that there is an official Lycoming oil filler neck that comes the right size for our cowl and costs the earth (i.e. $10.95) from a Lyc. dealer. (Haglund at Long Beach airport). JJ86/7.

#10/1 Chuch Smithfield can increase engine performance 20% without decreasing engine life by balancing, cylinder head laminar flow enhancement, and "c.c.ing" the combustion chambers.

For article on Engine Balancing, See library item #21. The local Lyc rep doesn't think it is worth the money.

JJ83/1 Lycomings: watch out for high temp on initial runup‑Do not let CHT exceed 400oor oil temp to exceed 200o. Melville prefers engine temp to run at about 280o.

There is a good Light Plane Maintenance article on Engine Break In after Top Overhaul, Library item #19.

There is also a large set of engine care articles grouped in Library item #32A‑D.

FM87/11 Breakin philosophy is changing. If you find no external leaks, run the engine normally. Don't baby it.

Install the engine on the aircraft and operate the engine the shortest time possible to look for leaks. Fly about an hour and carefully monitor CHT, expect a slight decrease at about 35 to 40 minutes at which time smoking should stop too, indicating seated rings. Look for loose starter and alternator brakets frequently throughout.

We pulled the plugs on an 0‑235L2C the other day after it was running rough. We had what appeared to be brown sugar fall out of the lower spark plug hole. It also caked the spark blug insulator. AM86/14

We talked to Lycoming and confirmed that it was lead. We were told to look into the spark plug holes for a ring of lead and to carefully dislodge it and remove it. Lead usually disolves in lean operation. However, on the 0‑235 the engine needs to be operated at a higher idle 1100‑1200rpm to avoid fouling, unless you are taxiing too fast. See Lyc Service letter 195A. When shutting down, run it up to 1800rpm for a short while, then pull back gradually, as it goes through 1200rpm pull mixture. Don't idle in a descent if possible.

Why hadn't the "brown sugar" dissoved this time? According to Lyc, even a small amount of silica (dust is just as much silica as sand) combines with the lead and makes the lead harden. A slight leak in the air box from Carb heat or other unfiltered air on the intake gives either warm air which changes mixture needs or dust. An oil analysis will confirm this problem.

Don Lewis has retired from Lyc and is now working at Western Cylinder Overhaul (818‑786‑7772). AM86/14

FM87/13: The typical engine abuse consists of: 1. Insufficient warm‑up time, 2. Inadequate oil change intervals, and 3. Setting cruise mixtures too lean (get an EGT indicator).

FM87/11: Of note, the 100LL fuel causes fouling. 0‑235s are susceptable to valve guide damage due to fact valve guide will seize the valve stem which pulls the guide loose and causes great damage. Some use autofuel as the solution. Not recommended.

Light Plane Maint Aug87/5: Reusable FAA‑PMA rocker cover gaskets for TCM & Lyc engines are available from Real Gasket Corp. POBox 1366, Laurel, MS 39441 601‑649‑0702.

For further details on the TBO change, see JJ86/8 For the need to adhere to TBO see FM87/9: Only Commercial operators need honor TBOs. To run past TBO you should consider:

6) When at TBO your aircraft value depreciates by the cost of an overhaul.

7) How is the oil pressure? Are you having to adjust it frequently to maintain normal pressure? If so suspect high main and rod bearing wear which also leads to higher oil temp.

8) Excessive venting from engine crankcase breather‑faulty piston rings.

9) Compression check is important. If only 3 & 4 are wrong, a Top Overhaul may be sufficient.

Engine source: The author has purchased a Tomahawk wreck and will eventually outline the ease/difficulty of shrinking things into a Long EZ chassis. If interested in the interim, please call. AM86/17

If the engine is going to sit around‑you should replace the four top plugs with dehydrator plugs ($2.75 ea) which turn color when wet. They can be set in oven to dry out again. Bill Reid is donating a set to Sq. 2. Source: All A/C Parts, 7612 Balboa, Van Nuys 818‑894‑9115 AM86/4

**Mazdas:**

AM85/2: There are rumors of Duncan Rotary(mazda) engines proliferating in the field. For it is new cost under $5,000?, narrower engine compartment, and more horsepower? Against it are the fears of the modern Bede problems, the apparent illusiveness of proof through owner useage. One high experience builder at Santa Monica was going to try one out, cancelled the order and still hasn't got his money back. Wouldn't it be prudent to await a 1000 hour report? Recent rumor is that he has been jailed for his methods.

Of note we have just received a brochure from Aerotek who plans to sell Mazda RO‑40A (120hp) and RO‑80A (225hp) liquid cooled engines that weigh with accessories (not radiator?) 190lbs and 255lbs respectively. 22" high, 24" wide and 28" or 32" respectively. Aerotek has scribbled in "Current prices range $7,000 to $9,000 (subject to change) Approx 6 mos delivery, tech details available in the Spring. \*Please note that our parent company is a well established, reputable mazda racing & service establishment. References supplied with purchase proposal". Library Item #35B

One Jungbloed of Los Angeles is also exploring Mazda power with gears, not belts. See Particulars AM86/10,11. He is at Chino Airport now, opposite the bomber at the Planes of Fame entrance.

Experimental engines, including the rotary, are not something to be tested on the Long EZ. Better on a J‑3 or Defiant, where the frequent early engine shut downs cause less off airport problems.

Lynn Burks speaks well of Coastal Aviation Cylinder Overhaul, 714‑736‑6452 at 1965 Aviation Rd. Corona, CA 91720. AS85/8

For Bill Reid's back seat throttle control plans, see Library item 54G.

JJ86/1 Joe Heapy has the authoritative answer to all the confusion on the number of bots and screws in the alum brackets that hold the engine mount. There should be two bolts (1 vert. and 1 horiz.) and 4 screws located not to interfere with bolts.

**PROPS**

**Prop Extensions:**

Despite rumor, Rotordyne is still making cheaper Prop extensions than Brock. Owner Robert Reese has prices: 213‑849‑4782, 1006 West Oak, Burbank, CA 90506. List and Photos, SQadron 2 Library item 41C. AM86/17

Al Boudreau of Tullahoma TENN (617‑455‑4728) is running an 8" extension and Sports Flight cowl and notes increased vibration between 2200 and 2500RPM between 95 to 115 knots‑ anyone else with this? CSN Mar86.

Propellers

Great American Propeller, (805‑481‑9054 1180 Pike Lane #5, Oceano, CA. 93445) comes well recommended. If you want a prop, give them the specs on their application sheet (need to know engine type, hp etc) and 8 weeks to build the things. For price list and installation procedures, see library item #41.

Video: Sq2 has a video of the Great American presentation on mounting props, pay $2.00 to rent or $15.00 to buy.

Propeller Hints from Great American, other than the installation procedures set out in library item #41A. For Prince A/C(non‑approved) Prop information #41B, For MT‑Propeller information #41D. Library Item #41E:

Propellers, Aopa Pilot Jun81 and #41F: Know your Propellers, Aopa Pilot Sep78.

Select Prop Bolts: Always have 7 bolts available for the 6 holes. See that each bolt you buy is straight by rolling it's shaft along the table edge. Have enough thred on the bolt to be sure the tip is flush or up to 2 threds exposed through the back of the drive lugs on prop extension. The bolt lengths must be carefully measured by adding washer(s)(use no more than three), crush plate, prop, back plate, extension outer flange and lug flange. The bolt threads should themselves be checked for thred dimensions (they can be too fat). If one bolt at any time does not fit the lug, check others before trying to remedy the problem, the bolts and lugs differ. Check lug bushings, the length of threaded portion should be 1 1/2 times the width of the bolt. It's important to clean the bolt threads but bees wax or ski wax on the bolt shaft is ok. whatever you do, don't bottom the bolt out rather than tightening down the prop. (i.e. know how many threds are exposed when the bolt is bottomed out.

Order of parts from outside in (1) Spinner, installed last (2) Bolt heads, (3) 1‑3 AN washers, (4) must have crush plate (ring with 6 holes in it) (5) Prop, mounted with blade near horizontal when mag appropriately positioned for prop starting (with appropriate mag for "propping") (6) Back plate for spinner, (7) Drive lugs protruding from extension at least 1/2" on smaller engines (8) Extension with 0‑2 threads of prop bolt exposed from drive lug flange. On first successful mounting, be sure to mark each level from engine drive to spinner with dot or "x" opposite one bolt position so that each item can be mated the same way each time. The spinner should be closely cowled to the prop blades (1/8" gap top avoid any damage to wood). Watch on first start up that spinner is centered‑off center spinners get thrown off in flight.

Each surface from drive shaft to crush plate must be clean. A little off centered material like paint, moves the prop tip off track like any levered item. When tracking (no need to start up to track) be sure to have drive shaft against front or back stop. The engine's end play can be more than FAA allowable track variance (1/16") You can correct track by adding up to 4 lbs of torque to the three bolts on one blade side. Use .040 or better (not .025) safety wire‑be sure to safety two bolts per wire, so one that backs off will tighten the other one.

One of the benefits of a wooden prop is that less damage is transmitted to the drive shaft by a prop strike. When you park your EZ, be sure the prop is horizontal so that it doesn't become wet in one end, and also so that if you lose the front end only the winglet will hit the ground. When ordering, let the prop company know your engine and aircraft information so they can get prop dimensions. Be sure to highly wax the prop with hard wax to avoid nicks. Great American Prop has a loaner program at the cost of transportation and repairs any manufacturer's prop. Little pits can be repaired on the aircraft by filling them with epoxy and sanding down and recovering.

For a computer program on propeller design, see library item #36.

Rumor: Bruce Tifft is getting enough unhappy feedback on 63 x 66 props on O‑235 engines that he will be using only the standard 62 x 66 props.

#11/2 Jim Nickless and Jim Sardella may build a prop balancer.

#10/1 Use only RAF recommended Propellers.

#10/1 Use fiber washers to help hold the spinners on.

Variable pitch allows movement of the propeller's "bite". Constant Speed props allow a governor to move the "bite" so that the engine speed stays the same, provided enough throttle is present. Most people confuse these two terms.

Tony Hoskins is studying a European variable pitch (constant speed) propeller. He's at 916‑273‑6688.

Great American is in a serious development phase on an electrically operated variable pitch propeller.

Mike Melville doesn't approve of Variable pitch propellers much. Or for that matter the Warnicke "almost constant speed" blades. While discussing propellers, he lectures that the function of prop bolts is to apply friction to prop and crush plate and extension, the bolts and lugs serve only that purpose. So, get a 1/2" thick crush plate that is fully the size of the propeller hub and be sure the surfaces are flat.

Lyc serv letter SL1435 deals with conversion from fixed to variable pitched props.

Bob Prior, Sq 1, has a working 4 bladed prop. Advantages: Smooth and a great brake device at idle. Sexy. Disadvantages: A slower aircraft on same engine as two bladed prop.

CS SP87/10, Cliff Cady 703 S. Regent Circle, Brandon Fl. is doing a prop and Performance survey.

Performance Propellers, Box 486, Salero Rd., Patagonia, AZ 85624 602-394-2059 (Clark Lydick). The 2 blade prop, $625, with rain proof leading edge and durathane cover. need to know bolt size and horsepower. If both ends are the same, it is an SAE 2, and they use 3/8 or 7/16 bolts with 5/8 lugs. 10 week lead time. He also sell a 3 blade, but shipping can be outrageous unless it accompanies yours. They run about $1400!

**Spinners**

CS' Russ Page, CS Sep86/7: Found he had to buy two spinners because his first was based on an estimate prop thickness that proved to be incorrect. Be sure of all dimensions before ordering the thing.

The Brocks mentioned that while there is a difference of opinion, the RAF folks have suggested a stiffener or bulkhead be placed aft of the prop near the crush plate inside the spinner to keep it from wobbling under power. JJ86/7.

CS'Messinger on homebuilt spinner from scratch, in exotic shape, see Library Item # .

See further discussion under cowls below.

**Engine Mount/Spar**

One of the best persons to get good advice from on mounts is Bob Callender of Barry Controls 2323 Valley St. Burbank CA 91505 818‑843‑1000.

Welder: Lew Barlow, Barlow Custom Welding, 1495 W9th, Upland, CA. (714) 981‑6911.

One builder suggests that with mere 1" by 1" upper extrusions and Brock Brake arms, there isn't enough room for the hinge bolt (AN4‑14).

AS83/2 Kreidels noted that their dynafocal mount sagged after several hours about 1/4 inch. Plan accordingly around exhaust ports.

The exposed portion of the spar should be protected against the exhaust pipe heat, particularly the large Sanders exhausts, as should the wing root.

Around the engine attach and other stress areas, be sure to have bolts in precision holes. Drill 1/64th small, use a reamer to bring out to the exact size of your bolts. Just hoping for the best and tightening down the bolts is not good enough. If a hole is just slightly outsized, the NAS close tolerance bolts are slightly larger. Drill steel then aluminum when the two mate.

Weldtech makes a conical mount for 0‑235 with and without Bendix mags. See library 2MS3.

FM87/13: The vertical plane of the engine as mounted on the airframe is more cosmetic than critical. If it was beyond a critical location the engine would be so ugly as to be obviously out of alignment.

FM87/14: To inspect rubber engine mounts, look for droop. Then use light and magnifying glass for cracks and deterioration. Push prop end of engine around to reveal cracks. New conical mounts are available in most

Dave Ronneberg suggested bigger L brackets 1.5”x1.5” to replace the 1”x1” if you go to the heavier engine. If retrofit, at least the top two would be worth doing.

**Aircraft Parts Distributors.**

CS' Steichen's drawing suggests a 3/16" safety cable covered in high temp plastic‑to prevent engine loss with a mount failure or prop failure. RAF told him to swage each end of the cable to the top firewall portion of the engine mounts. The diagram shows it going from mount under the closest jug, over the furthest aft jug, under the driveshaft portion of the housing and presumably over the other aft jug on the opposite side, under the one closest to the firewall and up to the other engine mount. (others have suggested the cable go around the center section spars, in case the mount separates too).

Mike Melville doesn't think the extra weight of the Weldtech (5 1/2lbs) is worthwhile. Their claim of allowing Bendix is a little strange too, it is the extrusions that hit the bendix mags, not the mount itself. If changing to larger engines, he suggests the extrusions were originally designed for a 85hp engine and should be beefed to 4 1" x 1 1/2" extrusions in original construction or at least the top two changed to 1" x 1 1/2" extrusions on engine changes to take the extra torque/weight. A simple way to add the extrusions is to cut off the top two at the firewall and mount the new ones on the outer side of the two top extrusions, with all the extra plies there too.

**Cowls & NACAs**

FM87/2 Didier Makowski also manufactures cowls for about $320 per set for O‑320 engines, useable on smaller. 213‑397‑4110(O) and 213‑390‑1082(H).

See the discussion at the end of this chapter on the Ellison experimental cowls.

For an article on Fitting and installing the Cowling, Sport Av May86 get library item 38C ($.25)

ON83/4,5 Sander's describes his new cowls (See library item #9 for catalogue). One builder notes the Task cowls are prone to springing up like a stiff collar on prom night. The Sanders cowls are so much easier to mount and fit better generally. For larger engines, the Sanders cowls have 1/2" more clearance at the critical points.

Task and Aircraft Spruce(?) cowl ribs (running parallel to prop) need reinforcement on their straight section for heat/mounting stress cracks.

Cowls are now available from Dave Ronneberg at Santa Monica. He has also done a videotape on cowls and installation of cowls and the wing/spar gap seals for builder support, contact author for it.

When adding extrusions to the top longerons, Mike added top side fairings to the cowls that basically cut out the sharp rise over the front jugs on the engine. The fairings come ahead of the firewall for some distance. Mike is convinced the highest drag problem is where the air is packed up on the leading bumps of the cowl next to the canopy. (The Sportflight cowls help too). The other area of drag is the area where the cowl comes up to th When fitting engine cowling, install the trailing edge pieces on the aircraft rather than trying to do it on the floor, for a closer fit.

Good time to do the spar/wing gap is when wrestling the cowl. See the Ronneberg Video‑Sq 2 library. Watch out for the bid pads and metal parts when separating things back out. AM86/14

When placing camlocks, the experience is that you should get one size, say ‑7s and use a depth guage to either sand BID on the tabs or add BID to the tabs to get uniform depth for camlocks. In Ontario, a good source for cheap camlocks is B & J A/C near the 60 fwy and Euclid. We are researching another cheap place in Van Nuys. AM86/18

Cowl cooling: Sam Kreidel has lectured on the 15 stages of their development of an efficient cooling system. They utilize the Melville slicer, a 1" by 1" bent .040" aluminum full width "L" shaped diverter which is mounted on and below the firewall to divert NACA boundary air straight up into the accessories. They then use a large jumbo diverter that looks like a fancy log splitter with its tip on the floor of the NACA under the firewall and the shoulders 8" back. The device was first carved and tested in bare blue foam and the shoulders were trimmed unevenly to bring the rear (propeller side) cylinders into temp with the front (firewall side) cylinders which were being cooled by directing air at them. They toyed with a number of other ideas including drooping the NACA lip, moving the aft baffle forward (limited success) ramping the exit area (limited success) moving the prop toward the engine, eliminating the top cross engine baffle, dropping the forward edge of the baffles down, placing a baffle that leans forward from back baffle toward the engine (definite success) and installing cooling 2" scat tubes that took air from NACA mouth directly to cylinders (good cooling, tricky to tune and probably a danger of overcooling spots on engine. They report that some sort of cowl flap, and Dick Rutan has one, would be a great way to reduce cooling in descent‑something that plagues their new, bigger engine and actually may increase airspeed. AM86/18

AM86/25‑9 see Kreidel's own full analysis on cooling this way.

On NACA Duct research, see Library item #34A.

Kreidels experimented with NACA duct. They emphasize leading edge configuration. Florida design is OK. Use 12" wide for O235C 15" for larger engines. This is still important in their latest tests.

Kreidels also "ramped" the stiffeners in the cowls to increase airflow through NACA. This proved to be unnecessary in later tests of direct ramp cooling.

A consensus is developing that NACAs don't pressurize the cowl as previously thought. Melville is experimenting, successfully, with ramps on the lower cowl designed to bend the air against each cylinder. From pictures they look like the seats of a car with front buckets and rear bench, and the appropriate front seat moved aft appropriate to the cylinder offset. The "seats" are smooth curves from thigh to shoulder and the front "seats" take up about 65% of the width of the bottom of the cowl. The rear bench fills the whole aft bottom of it.

The result is cyl. temps less than 10oF apart from #1 to #4 cyl. and low enough.

For best heat dissipation, a couple of builders have suggested that the engine compartment, cowl insides and engine mount should be painted a flame proof white paint. CS's Jamison has a complex fiberfrax approach that is not worth repeating here. If interested, see CS Ju86/9.

For a drawing of the cooling deflectors installed on the bottom NACA inlet style cowl of Mark McHenry wherein he shows 2 smaller deflectors that direct air from the NACA lip up to the front two cylinders and a second deflector to direct all of the remaining air at the other cylinders, and effectively block off the rear of the cowl, and a small drain hole behind the rear deflector, and clearance of 1" from cylindars and hoses, see DJ86/3.

JJ83/2 Herb Sanders of Sports Flight has new Kevlar cowls incorporating NACA ducts, extended fairing toward prop and smoother engine blisters for about same price as authorized ones. Should result in faster speeds, better cooling and less turbulence near prop. Sanders also has Exhaust system with cabin heat option (See catalogue, library item #9.)

#8/4: See Sam Kreidel for advice on NACA inlet.

If you are going to put in a NACA duct, Jim Nickless has a plaster plug of a NACA inlet to lend at Sq. 1.

The Army Long EZ has "Armpit Scoops" necessitated by the junk they hang under the fuselage which would block the NACA or standard scoop. The air is directed right at the cylinders and works well. AM86/13

CS Ju867, CS's Jamison discusses lengthening the cowl, keeping 50 Square inches of rear opening, mating 1/2" from a prop on a 6" extension. The same builder later removed the spinner for increased, documented cooling. Ronneberg is coming to the conclusion the spinner should mate with the cowl as closely as possible and is going to install a larger spinner.

Claus Savier, a very fast man, sells, through Aircraft Spruce, a spinner that is meant for pushers, not tractors. He says that on the aft of the prop the pressure is so much higher that the air sticks to the spinner curves and on the normal spinner the air collides at the rounded tip. His spinner smooths out the air and one of his customers claims 3 mph improvement with the light weight spinner on a standard Spruce back plate.

**Baffling**

FM87/10: Be sure baffling and cowls takes into effect heating while the aircraft is sitting on the ground.

The trend we have seen on baffles is to closely baffle the cylinders and tie the baffle tips to each other accross top and bottom. Dave Ronneberg has added little lengths of brake line tube over the push rod tubes and behind the baffle tips to keep the wire from vibrating into the baffles.

Bruce Tifft is convinced that exhausting the oil cooler air before it mixes in with the other air going through the baffles is a must. He says that the air in the area about 9" short of the prop on the lower cowl is nearly dead. As a result, he has moved the exhaust of his oil cooler to a position right in the bottom of the lower cowl, with the intake right aft of the cowl intake. Others, like Ronneberg, put the oil cooler aft of the cylinders in some installations, but more recently near the aft side of the sump with the exhaust directed at the lower baffle below the alternator/starter. Dave insists on Positech Oil Coolers. 11 row for the O-360s.

CS' Bach on his 0‑235 C‑1 baffles and ramps post Kreidel, see library Item # .

IVCHC's Brin(Spring87/2) suggests that he and Reynolds have opened up the usual Scoop to eliminate the splitter designed to divert the bottom flow away from the inlet. They find the cooling superior with this straight inlet opening. Do not confuse this with the NACA design. This is a modified scoop.

Pat O'Brien, of SQ 2, alias O'Products, 805‑499‑7369 sells cowl plugs to keep the moisture our of your nose‑down bird, with a zipper bag that fits in the turtle deck area. He also sells a custom made stick grip.

For best heat protection, a couple of builders have suggested that the engine compartment, cowl insides and engine mount should be painted a flame proof white paint.

One builder has seen his lower cowl attach lip crumble due to vibration and oil soak, keep an eye out. IV271

**Magnetos**

Mag Switches.... The best arrangement I have seen is a pair of covered toggles on the left top of the instrument panel so that if a prop blade flies off you can slap the covers down and turn off the engine before it tears off the aircraft. I like the idea of switches on the head rest for the back seater to turn off the engine, but, I carry children who may get curious about the switches as we are in some critical phase of flight.

FM87/12 Be sure to time your magneto correctly. Expect to see either a Slick 4000, 4100 or 4200 series magneto with M‑2363 Ignition harness assbly. or Bendix SF‑4‑LN‑8. Slick has just issued a service bulletin suggesting bearing replacement in the mags installed in 0‑320, 0‑360 and 0‑235 C1C and C2C engines, mag models 4250, 4250R, 4251, 4251R, 4252, 4252R.

Squadron 2 Library items:

#40A Slick Mag brochures.

#40B, ON83/7 Mag timing, see also ON86.

#40D Kreidel on Slick Mag installation tips. FM86/12/13, see summary below.

#40C For a simple Magneto timer that can be constructed out of Radio Shack parts, See DJ86/14.

***Builder Hint*:** The engine you get should have and slick mags, there is a suggestion that the Bendix mags are interferred with by the engine mount. This is not so, for Brock or Weldtech. The real problem is the aluminum extrusions which collide with the Bendix mags in a portion of their timing arc.

#10/1 Use dual impulse coupling magneto on one side for easier starting.

Materials committee: Slick Mags have been subject to some arcing problems on earlier models, check to see that changes have been accomplished.

Video: Sq2 has a video of the Slick Mag slide lecture. $2.00 to borrow, $15 to own.

Slick mags may require work a 250 hour intervals, don't drive them unless you have checked this with the literature available from lycoming on the engines.

The Kreidels have outlined in detail how to create a reliable P lead on the magneto. In summary, you actually ground the shielded cable at switch and magneto ends, you should use an MS25171‑1 rubber boot over the connector and treaded post and do not use a locknut on that post, too much chance of torquing and grounding the post. They also suggest leaving the "P" lead long so that it can be more easily serviced, tack the excess to the firewall.

CS' Saffron states that B & D electronic tach people give written instructions to install a 15K resistor directly on the mag "p" terminals. B & D orally reports they mean the ignitions switch‑the functional equivalent of the "p" terminals. He still found false drop indications when on one mag.

Spark Plugs O‑235‑L engines use 5/8" ‑24 as SR‑86, \*SR‑83P and \*SR‑93 plugs 3/4" ‑ 20 is HSR‑87, \*HSR‑83P and \*HSR‑93 plugs. The \* indicates precious metal plugs.

Sq 2 Library item #46: Low cost plug servicing, A pilot's guide (light Plane Maint.)

There is a refurbisher in the Van Nuys area that is quite cheap.

**Exhausts**

#11/4 Wes Page has Engine Mounts and Cross‑Over Exhausts.

#10/1 Paul Prout has his plans available for installing a heat muff on Brock exhausts.

#10/1 Brock Exhaust support tabs should be left off, they crack and don't appear to be necessary.

Exhaust Pipe Supplier: Custom Aircraft Parts, 1318 Gertrude St, San Diego 92110 for light, no‑springs pipes.

AS86/6: The Kreidels ask what can be done to avoid exhaust leaks at slip joints in Sport Flight exhausts. A number of people hav developed new exhaust systems‑Mike Melvilles is potentially the best with 4 separate stacks.

**Accessories and Others**

**Cockpit heaters**

George Kelley, to enhance the Exhaust based heater's ability to "blow" air into the cockpit, has placed two 1 1/4" vents through the bottom of the aircraft outside both sides of his NACA duct with partial covers that induce air flow out of the aircraft. The inner end is behind the back seat. (Vents up in the canopy area would allow a lot of noise in). He then controls heat or vent with the inlets. You have to use monoxide indicators.

Eric Cobb has purchased a "rear window defroster" from the Whitney catalogue that uses 12v, uses 13.5 amps and weighs about 1 lb. Catalogue item 15FY7993P without remote switch ($14.88) or 15FY7994P with remote toggle switch ($15.88). Call 312‑431‑6102 to order. Eric finds it slightly better than an extra pair of woolen socks. Wall‑397‑4110. For Catalogue page, Library Item #61B. AM96/16

One of the Sq 1 people is evaluating an electronic micro‑monitor built carbon monoxide detector to hook up to any warning system. In combination with a backup passive "dot" style indicator the exhaust style heater should be much safer. AM86/18

The most successful way to keep the pilot's feet warm is the use of "bunny boots" or "Snow boots", those bulky ones that are quite light.

CS's Jamison went to great lengths to get heat (CS Ju86/3): He used 20 amp electric heater instead of exhaust type. He regrets weight of alternator considering inadequate heat. In sun, 40F OAT, long johns and jacket it is tolerable. With electric this is good to 30F OAT. No sun, add 5F to OAT to be tolerable. He sealed canopy well, and elevator tubes but this makes for fogging due to no air flow. Suggests engine source heat. Instead he put in an elaborate two way oil valve to cooler or to cabin tube running up and down fuselage. He cools the oil to 160F, the minimum, that way, in low power cruise. Insulation was important in some points. With it, electric heat, no long johns and no sun, he's ok down to 30F OAT. With no sun, the canopy fogs up and a defroster is needed. With both heaters, long johns, heavy boots he can tolerage 20F OAT.

**Filters**

#9/1: Wes Gardner's air filter gives benefit of cleaning small particles, it is reuseable at $10.95, and should be cleaned every 25 hours.(714) 792‑1565

ON84/2 San Diegans find good fuel filter is a P/N 3034 NAPA (auto) filter.

For article on Flexible aircraft hoses, library item #25.

AM84/3 read Kreidel hint on a different air filter.

Tom McNeely suggests that a screw on oil filter from a Renault/Volvo/Peugeot V6 clears the firewall on a standard Lyc. The part was thought to be a Fram PH3513, Purolator FCO‑101. Safety it by adding a large radiator clamp to attach safety wire. Question: can you get the full 7 gals/min through these filters? FM86/3 We contacted FRAM's Dave Texera (401‑434‑7000 Engineering, Liquid Lab) and got him to dig into specs. He says that there is no PH3513, but there is a PH3512 for a '68‑84 Renault which is about 3" by 3". It contains a relief valve that opens when "delta P" (pressure accross the filter) reaches 7 to 9 psi. He said that his papers show that with 3 gallons per minute flow the filter yields a 6 psi "delta P". Furthermore, the filter, with such a small filter area available, has a short life, measured in dirt level. The relief valve opens at 2 grams dirt. AM86/17

Carbs or Throttle Bodies

DJ84/8 Review safetying article. Library Item #54F.

Melville will not recommend the Ellison throttle body as it stumbles badly at full open. He feels that without a true venturi effect when wide open, the Ellison needs a stop to keep the throttle from opening past about 7/8 open. Wes Gardner has installed such a stop, but Ellison hasn't come around.

Marty Ellison spoke to Squadron 2 in August 1985 and feels that Melville probably misdiagnosed the problem with his throttle body. First, he believes that the stumbling Melville was having is related to something he has heard described with regular carbs: the 900 bend in the throttle inlet path, if too close to the mouth of the carb or throttle body results in a constriction or turbulance that actually restricts the amount of air that can bend into the throat of the device. As a result, the mixture just richens for the last part of the throttle. The quick fix for several Long EZ builders has been to put a limit on the slide so that the throttle throat isn't fully opened. (Ellison believes the quick fix on the Marvel Schebler has been to supply it with different carb mouths, differing as the Cessna air box differs from year to year). The better fix, perhaps limited by the cowl, is to move the 900 bend out (down) to about 3" if possible so that the air straightens up before hitting the throat. He says his one experiment with placing honeycomb guides to turn and smooth the air had no effect.

Ellison feels that Melville couldn't dislike the Throttle body too much as Melville has now bought (as opposed to RAF tested) his own for his new engine installation. The throttle body does ice, though probably with less dire results than the icing of a butterfly in a carb. The throttle body, not having the reserve of a float bowl, is more liable to vapor lock although the Long EZ has much less problems because the throttle body is on the cool side of the engine. Hot side installations in other aircraft are a real problem and require cool air directed at the fuel components. The usual source of air for the vapor lock is leaks in the system, particularly the primer pump end. Because the spring return on a throttle body is more likely to bind up, Ellison suggests a Morris Cable be used instead of the Plans throttle cable which has poor "push" characteristics. Marty claims that because the throttle body opens and meters at the best mixture at all settings that it always provides atomized fuel evenly to all cylinders which he believes is the defect in carbed aircraft which have specific hot cylinders. Ellison credits the even atomized fuel (no dripping in the throat) with the better fuel consumption he gets. He claims 1 to 1 and 1/2 gallons per hour less than a carb, about 15 to 20% improvement.

By the way, Ellison uses the same exact numbering system for his throttle bodies as the Marvel boys‑it is no copy‑cat approach, the number system is actually an SAE standard that both use to describe their units. The throttle body is a hard starter on cold days. A primer is a good idea.

In Reply to the information supplied in the last newsletter on the Ellison lecture, Mike Melville notes the following:

Melville did not misdiagnose his problem with the Ellison Throttle Body he received first. He did not have a problem with a close 90o bend before the throttle body. He didn't even have a bend near. He flew it only with a wire screen and later with an auto type aircleaner directly on the throttle body. The unit he first received a unit with no venturi, but his new one definitely has a venturi shape and works great. He did buy it and likes it.

**Squadron 2 Library Items:**

#43I: CS Ju86/13: Bianconi on fuels and fuel systems.

#44A: Ellison Throttlebody materials.

#44B: Photos and plan on 90o box for throttle body to engine.

#60F: Videotape of Ellison Throttlebody Tests.

Florida Feb86/2,3: For an interesting article on the steps necessary to install an Ellison throttle body injector.

#34C: The Ellisons had a radical Cowl on their craft with the design objective of providing "throttleable" cooling for the Oil cooler seperate from the rest of the engine. Ellison believes that Oil temperature is related more to rpm than load and therefore needs special treatment. The new cowl is too efficient and had to have cowl flaps. ON85/9

CS Mar86/7: When connecting up the Carb to Filter, it is easy for the hose to become collapsed‑cutting off your whole day. Check for deteriorated hoses.

CS Jun86/9: VariEZ carb heat box keeps coming loose from exhaust pipe per CS's Jamison, so he moved to a Cessna unit that works well (Aircraft Spruce).

CS Jun86/13: For an interesting analysis of leaning and fuels, see Art

**Primers**

Weldtech manufactures Throttle quadrants and Fuel primer kits in Wash state. See library item #9B. (Ellison, in Wash state, had never heard of them).

One builder who had to have a primer (because of carb choice) installed the primer handle in the notch behind the passenger head rest‑you only need it when you are getting into the plane on the ground, and the routing is much simpler, lighter, and saves fuel running around extra cocpit lines. JJ85/4

How to Repair a Kohler Primer, Light Plane Maint, Mar87, Library Item #43

**Fuel Pumps:**

Florida Feb86/3: If you have a mechanical fuel pump but no fittings, you need two AC part No 6470069 adapters at $15.00 each. The catalogues don't list them but aircraft parts stores have them.

Florida Feb86/3,4: Plans electric fuel pump has 1/8" pipe threads which looks too chincy for one builder who decided to get the Sport Flight one that has 3/8" fittings instead. 904‑796‑1874. While on 3/8" tubes, the FAA Aircraft Repair Manual requires double flairing on all aluminum tubing 3/8" and larger. The tool for the job is a 37 flairing tool (i.e. Industrial 800‑521‑4800).

FM87/9,10: The Mechanical Fuel pump of choice on the Lyc 0‑235 is the AC type # 40295 Lyc part number

Lw‑15472. vent it overboard in case of a pump failure.

*INJECTORS –*

*9/09: Rails below the injectors: Redmon: You will however, get fuel running back down into your servo and out the air filter.  This is normal.  I'll also caveat, the spider is on the bottom of the engine, and all the injector lines run uphill.*

**Misc**

Squadron 2 Library Items:

#53B Synthetic Oil, Av Consumer Nov 85 (.30)

If you have Cylinder head temp guage, be sure it works on each cylinder. Don't assume the senders are sending correct temp. Load them all in hot water and check the output of each and then calibrate. Thermocouples can be off by quite a bit and still be considered normal. AM86/15

For Vacuum pumps, see Instrument section in Chapter 22.

FM87/10: for discussion on inverted oil systems see discussion in newsletter.

Wes Gardner sells an oil seperator kit for $110 that covers all pipes, and a complex little oil separator that works well. He's located out at riverside.

CS's Jamison says it works, but returns some water to the oil. He instead installed a stretched coil spring in the breather hose which now runs up through the forward engine baffle and then down to the anti‑backfire valveon the exhaust pipe. This allows less water back. The stainless tube out of the exhaust extends about 4" so the tube does not see the exhaust metal temps. He later removed the anti‑backfire valve with no problems.

**CHAPTER 24: COVERS/FAIRINGS/CONSOLES**

**Plans 24‑1**

Leave consoles until last‑they get cut into if installed any earlier. They are structural, so don't make them removeable when you do finally fit them.

**Plans 24‑1 step 3:**

Some builders feel the back seater feels like he/she is always sliding out of the seat. They've tested seat bottoms that essentially duplicate the plans front seat rise 4 1/2" high and 8 1/2" slope from a point 10 1/2" forward of the back seatback. JJ85/4

Bill Reid has developed a second use for the drain hole recently mandated by the CPs. He put an eye on the back of the upper and lower hole cover and runs a spring between the two eyes to hold the covers on. He disconnects the spring to get at the wing bolts.

#10/1 Wheel fairing should be vented to allow heat buildup to dissipate.

J‑J/83/1 Paul Prout's "RT" higher profile wheel pants are now available for rough terrain. ($10.00). (714‑621‑0060)

#12/2 Buy Paul Prout's "Delta‑7"8lb. Wheel Pant design for 5 x 5 tires ($10.00). Library Item #14A.

DJ84/5 On Sport Flight pants‑see installation drawings of Sam Kreidel. (library item #14B).

Library item #14C: See also Cobb's hinge design for nose door‑bigger noses only.

Dave Ronneberg sells wheel pants for $150 per set. 213‑477‑5958. Didier Makowski competes: 213‑397‑4110. As far as we know, nobody has pants with the room for the new brakes. Every body is modifying existing pants‑it is about time.

For baggage pods, contact Bruce Tifft, the B & T Prop man.

CS Mar86/7 For instructions on installing baggage pods on varieze, Steve Wright, 1965 Sunnyside Drive, Brentwood, Tenn 37027.

**CHAPTER 25: FINISHING**

**Plans 25‑1**

**Finishing**

Squadron 2 Library items:

#60C Video from Burt's birthday lecture on finishing

#60E on filling gaps between wing and strake/spar.

#50A: May83/3 Finishing Composite Aircraft: Sport Av.

#50B: Finishing Composite Parts: Kitplanes.

#50C: DJ84/4 Kreidel on Finishing EZs. See summary below.

#50D: Stick on Stripes and Numbers, Sport Av. Feb86.

#50E: Steicken on finishing EZs. CS.

AM85/4,6: See the order of finishing: Sand then Micro, then featherfill or stirling plus balloons, then primer, then finish paint. Bob Brown has experimented with the Gougeon's West System as recommended by Melville.(see below). San Diego prices reported in ON85/3 i.e. 6 gallons for $212.53.

Dick Kreidel has a novel way of finishing involves putting a 1/8" layer of very dry (pie crust) micro over the entire outside surface, curing 2 days and then sanding with a 32" x 1" sanding block. He does not accept liability for your workmanship and procedures, but it saved him a considerable amount of time in building.

When trying to feel irregularities, your fingers are fooled by the sanding texture. Place thin paper under your fingers and then only the irregularities can be felt.

Dick Kreidel suggests Morton's Eliminator instead of pre‑primer fillers‑ others get more pin holes. Mortons is about 10% less than Stirling. Sanding Mortons dry is a pain‑it clogs the paper, necessitating a wire brush to avoid changing paper every few strokes. Dick advocates sanding it wet.

Use a 12" metal ruler to detect flat spots. Roll it on its hard edge and it will pop when flat spots are encountered (the pop comes from the ruler's hitting two points of congruence).

JJ83/4: Watch out for post cure headaches. If you try it, do not overheat the parts. The foam will actually shrink permanently resulting in ridges at micro joints even when in for 30 minutes in sun.

CS: Steichen's uses a 2' metal ruler, West System, straight line air sander with 80 grit. When contour is within 1/2mm everywhere he brushes on Sterling with 30% glass balloons and sands until he sees some glass 3 times with 80 grit. Then the 4th coat he does with 120 grit moving into hand sanding for the first time! (Most others suggest never machine sanding!) He then sprays Dupont Sand & Fill.

A "lightweight" auto body filler is USC Kromate Light‑ which may be worked with gross tools in minutes and sanded shortly thereafter. If unsanded, it seems to leave a wet bonding surface for next amount to be troweled in. But it may be closer to regular bondo than micro in weight. Stan Schneiderman has followed up on the Paint seminar and used Kromate Light with the extender called Honey and a 50/50 mix of microballoons quite well. It sands beautifully.

When separating the wing from spar after finishing wing, spar and strake surfaces, mark the hard points and don't cut into them!

One builder recommends two 3Ms 6" abrasive wheels on a drill, run "with the cloth" on UNI to get the shine out of the finish very quickly.

What ever you do, don't use no‑clog sand paper on your aircraft. They contain cling inhibiters like wax which defeats the mechanical and chemical bond of the next layer of finish.

Despite the old Rutan information, Dupont (and other) primer is not the UV barrier. It is the final paint that has the UV barrier. Further Dupont 100S may shrink a little in the sun. Some prefer Corlar.

Rutan now advises that undercoat of Dupont 70S is poor for the purpose, and 100s is better, but using the Dupont "system" is much better still. For the latest from Dupont, see Sq2 videotape of Dupont's representative.

***Builder Hint***: For those on the west side, Schneiderman has the number of a moonlighting autobody finisher with a light touch by the name of Steve.

Melville recalls using "the West System" for filling. He says to mix with microballoons. It comes from Goujoun Bros., Bay City, Wisconsin (517) 684‑6881 for orders, (517) 684‑7286 for inquiries. It mixes at a rate of 5 to 1 with two pumps in the lids. Ask for #105 Resin and #205 fast hardener, which kicks off in about 8‑10 minutes in the cup, sands without clogging or problems in transitions and cures in any weather in a few hours. It is pure white. The author ordered two "kits" and 1 set of pumps for $120 including shipping to Los Angeles. There is a dealer for this stuff at most big marinas, At Marina Del Rey, contact Michael Leneman 213‑821‑6762. His prices are about 8% over direct delivery even after shipping from the mid‑west is added to direct shipping.

Spruce advertises West Kits (5.25 gallons) for $226. You need about 5 gallons, most of which ends up on the floor. But note, for the same 5 gallons COD from the factory, a week later, I paid $188. You will need a one gallon can and the pumps either for the big cans or for the smaller cans to ratio the stuff. If you do want to use it in small kit, order the big one and see who has a 1 gallon kit cans around to use.

What ever you do, don't use no‑clog sand paper on your aircraft. They contain cling inhibiters like wax which defeat the whole mechanical and chemical bond necessary for your parts to connect and your paint to adhere.

Bob Hummel says that sheets of peel ply can be used to mold West Micro while it is wet, to save later needs for sanding and refilling. AM86/18

Despite the old Rutan information, Dupont (and other) primer is not the UV barrier. It is the final paint that has the UV barrier. Further Dupont 100S may shrink a little in the sun. Some prefer Corlar.

Rutan now advises that undercoat of Dupont 70S is poor for the purpose, and 100s is better, but using the Dupont "system" is much better still. For the latest from Dupont, see Sq2 videotape of Dupont's representative.

Dr. Harris suggests that Stirling is particularly dangerous and that one should definitely wear a charcoal mask. PR88 works well with it too. AM86/18

Nevertheless, Stirling is a favorite because of its color and ease of use. Watch out though, if it kicks off in the gun you'll be cleaning for days. Clean out with MEK the minute you finish a pot. If you screw up, try Gunk Hydro‑Seal Carbon Digestive Soap.

Squaron 2 heard from Scott of DETCO the distributor or Stitts. He has constructed a Long EZ application brochure. He makes a good impression and knows his product. For pro Stitts information‑Call Bill Reid 213‑459‑2614. For con‑Dick Kreidel 714‑961‑1846. Further info: AS86/1.

Dick Kreidel suggests Morton's Eliminator instead of pre‑primer fillers‑ others get more pin holes. Mortons is about 10% less than Stirling. Sanding Mortons dry is a pain‑it clogs the paper, necessitating a wire brush to avoid changing paper every few strokes. Dick advocates sanding it wet.

**Paint**

For less toxic paints see AS86/6.

The Hole‑in‑the‑Wall Gang advises you to fly off your hours in primer and then fine tune and paint afterwards.

Zoletone can be purchased directly from the Zoletone company in Los Angeles at a saving.

Squadron 2 has a Zoletone Paint sample card set. Zoletone may be purchased from Tumans, 1002 Santa Monica Blvd, SMO (393‑0546) and Mann Bros. 757 N. La Brea (936‑5168).

The inside of the cowl should be painted white to reduce heat penitration.

While the foam parts must be painted white, the non‑foam or special foam parts like the Cowls, strakes, gear and pants need not be white. Some obviously feel that things that are not in direct sunlight may also be painted other colors like the winglets and fuselage sides. Several builders note that the whole process of decorating the aircraft in color can be done easier and cheaper with the auto detailing decals than custom painting. Custom paint is nearly as thick and much less repairable.

It is thought that the pitch down in rain can also be markedly changed by taking 600 grit sandpaper and roughing the finish on the canard on the axis of flight (not spanwise). Is our finish so smooth that the water droplets bead up? AM85/6: The paint itself is the UV protection, specify it to your supplier. The foam and epoxy must be kept below 160 F which is why you paint with white or near white.

For paint and finishing brochures, see Library Item #48.

JJ86/4 Mike Mohaghah of Sherman‑Williams talked about his Sunfire 421‑Acrylic Urethane Enamel with 10 yr life, better chip resistance, better fade resistance and repairability. See brochure JJ86/9

Dale Wunderle 213‑749‑3481 Suggests ultra‑fill at 20‑30 PSI followed by Epoxy primer at 50‑55 PSI and Sunfire at 60‑65 PSI.

**N‑Numbers**

We discovered the other day that the FAA requires that new planes or those simply repainted actually require 12" characters & numbers or as large as will fit on a vertical surface. There is a proposal to require all aircraft that cross U.S. border to have 12" characters and numbers. A word to the wise, don't get adamant when defending your short N numbers with the FAA. Think of how the Europeans interpret your vertical surfaces‑i.e. under the cockpit they install those huge letters. Use peel on, peel offs. As silly as it sounds, I'd rather the tower could see my number when I'm waiting for takeoff.

CS' Horm Howell reports that you can have your sign painter order a pair of computer generated N numbers in various type faces from Gregory Inc. POBox 405, Buhler, Kansas 67522 800‑835‑2221. ($12?)

**CHAPTER 26: UPHOLSTRY**

#5/8 and May 10, 1982/2, Wes Hodges builds upholstry.

One builder advocates the use of Temperfoam for seat cushions, manufactured in the middlewest and distributed in the Southbay. It is light green, hard on sitting down and it then conforms to the rearend. It was developed for NASA and is designed to protect the pilot from strong impact. Another points out that at ambient temps below 60oF the foam stays hard, it is heavy and expensive.

There is a Santa Barbara fellow who sells custom sheep skin seat covers for the Long EZ. Lontact Bill Theeringer 805‑961‑5135. They are illegal in most aircraft due to fire uncertification.

Squadron 2 has a very professional upholstry man who is also a Long EZ builder. See library item #9K Chris Wade 213‑306‑7850.

**Oxygen systems:**

ON86/23‑29 brochure on Aerox system‑Library item #67J.

**CERTIFICATION:**

[**www.ez.org/downloads**](http://www.ez.org/downloads) **EZ Owner’s Manual - downloaded.**

Squadron 2 had a very interesting presentation by 3 finished builders. George Kelley who had his LongEZ certified under the old system, Clayton Kau and Ian Ayton who were certified under the new FAA system. AM85/3.

Squadron 2 recently gained access to a checklist that a local FAA man uses and was convinced to type out. Library Item #11H.

They agree that paperwork is a must, should be filled out and checked by another builder. The FAA inspector is a stickler on paper. When you get back your paperwork from the FAA and are ready, call the inspector who brings out a Temporary Operating Permit which is essentially filled out. All agree that if you ever plan to upgrade to IFR, Night, Acro etc that you try to get it all at once. On the 25hr 40hr disparity. Two used the analogy that Rutan used and had run the Great American prop that they had on their A/C for nearly 1000 hours and therefore it was virtually certified by Rutan. The FAA, faced with a certified engine and 'certified' prop, gave both a 25 hour flyoff.

As to the inspections, each ran into different conditions. The longer the paperwork takes, as long as amicable, including photos and receipts, the shorter the physical exam. Items of interest. Try to make Hobbs and Engine log reflect same number. In fact make all numbers correspond. All safety nuts in the engine compartment have to be all‑metal. You may be inspected on the radio station license. The nuts around the canopy where you could scratch yourself should be filed or cap nutted. One inspector was adamant that the battery terminals could not be exposed. Another insisted the generator be held in place by an adjusting bolt with a safety wire. Another checked aileron travel carefully. All suggest you try not to antagonize the inspector, be sure your shop is as clean as a factory floor is expected to be, and keep your mouth shut when ever there is a chance.

Squadron I had LeRoy Blum speak in July, 1985 about the "New Independent Inspection; another set of eyes". He is at Riverside FAA 714‑351‑6701.

There is a five page article in CS Newsletter on Certifying an Aircraft See Library Item #12F.

Dwayne Bunker has a Long EZ trailer, and may rent it out to you. There is a professional Aircraft Recovery trailer available at a repair business near the tower at Torrance Airport for $25 per day.

JJ84/3 SQ 1 & 2 have copies of the FARs applicable to homebuilders.

MAY83/20 SPORT AVIATION article on hassle free certification. Library item #11C For Kit Planes new article, Library Item #11B, for FAA documents, Library Item #11A. For Article on buying and selling Homebuilts, see Library Item #63.

The Kreidels did a written submission to the FAA to pass certification, see Library item #12A, Ayton has a log book test program #12B, for a Long EZ inspector's checklist, Library item #12E.

For article on buying and selling homebuilts,(Sport Aviation) Library Item #63.

#12/3 FAA Registration, 60 days before completion send $5.00 to FAA Oklahoma with a bill of sale or a signed, notarized, affidavit declaring ownership.

AS83/3 on FAA Advisory Circular No. 20‑27C, dated April 1, 1983, setting out the newest FAA Certification procedures.

#12/3 Common FAA inspection failures:

Not marking instruments and showing minimum and normal operating range.

10) Failure to install rubber boots over battery and Solenoid connectors.

11) Control interference problems.

12) Use of glass strainer bowls (use only metal ones).

The Kreidels printed up a summary of their 25 hour program in a format that passed two FAA inspectors at the Riverside GADO. (Each wanted different things done, so, a word to the wise, find out what your inspector wants in a fly‑off program. Ian Ayton did his in Log Book for , see Library item #12B.

Stan Shniderman had FAA designee (not FAA employee) Jerry Redmond do an inspection at Camarillo for $50.00. Jerry is very Thorough. Jerry finds the plackarding so often a problem that he will not even visit a project without first seeing photos of in progress project and final plackarding and FAA paperwoork. Jerry noted the following for repair before he signed Stan off the next day: 1. Stop bolts missing on ailerons. 2. No compass. 3. Safety wire on brake system missing. 4. Emergency canopy release(recommended but not required‑Stan used removeable hinge pins). 5. Remove all pencil marks on the spinner, graphite induces cracks in the aluminum spinner. 6. Drain to outside of cowl from the mechanical fuel pump. 7. Clamp on the induction system. 8. Master on/ off switch unlabelled. 9 Fuel Capacity to be measured off during flight test program and marked before final sign off.)

Jerry Sloan had his first flight in mid‑84. After waiting an age for paperwork Jerry called and expidited the paperwork out of Oklahoma. The FAA inspector, Wally Stinson, from the Van Nuys or Burbank office came out to inspect the factory next door to Jerry's hanger and came over and give the Long‑EZ a short look and got tough with the fact Jerry had some nuts on the speed brake that were not lock nuts, albeit aircraft type. Jerry finished that up quickly, Wally came back again, looked around for a few minutes, told Jerry he didn't want to look at the receipts, the builder's log (with or without signatures of experienced builders) or the photo album on construction. Then Mike Melville flew the thing off and was impressed at the lack of glitches. Jerry paid Mike for his trouble (apparently Mike was taken aback as nobody had ever offered before!).

SQ2 Speaker in October 1985 was the FAA's John Zarcone (213‑215‑2066). John thinks his job is to protect the public from you. He advises that your job is to "sell" your project to him. Do that by good worksmanship, photos and receipt book. If you think the FAA only knows aluminum airplanes, realize he officially followed the composite construction of the LearFan project in Reno. He suggests you have the thing fully assembled in town and covers off before calling. He comes out virtually any day you call. He routinely assigns 40 hour fly‑offs due to uncertificated props. Have your aircraft ready for the maximum of things you want to do. Day, Night, Instrument & Aerobatics can be flown in the 40 hours if you prep your plane for that. He usually doesn't inspect your craft after the hours are flown. Don't forget to call the other FAA ‑ General Aviation ‑ for your Repairman's certificate after your Aircraft is certificated.

Note change in MIDO to 215‑2066, flight standards 215‑2154.

Sam Kreidel is sure that the CG figures for the fuel tanks are wrong. The fuel is actually further aft when the plane is level. AM86/18

Don't forget that when you register you must also register the Aircraft as a radio station. Call the locall FCC.

Peter Freidman, an EAA designee, and owner of Aircraft Metal Products, II and IAW is thinking of becoming a Squadron 2 Long EZ final aircraft inspector in exchange for getting his twelve year old son's elbows in epoxy.

CS Sp87/3,4 The 1987 FARs for Pilots is available at 1 800‑542‑6657(CAL) or 1‑800‑423‑2708(non‑Cal) for $5.95 Aviation Book Co. 1640 Victory Blvd. Glendale 91201.

**Hangering:**

Does anyone have a simple design for an EZ hanger that can be submitted to Port‑A‑Port or others? I'll bet they would nest together and take half the room of the average hanger. Perhaps a door like the old TR‑7 wedge garage? There must be little places on airports that average hangers won't fit.

**INSURANCE:** See Supplier lists and May 10, 82/2

Squadron 2 Library Items:

#63D: How can they sue me? Sport Av Nov85.

#64A: Insurance‑ What's your coverage? Sport Av Sep85.

#64B: Reflections on RAF, Insurance and Liability.

#64C: Insuring your Homebuilt‑Kitplanes Sep86.

#64D: Ad for Senior Pilot's Insurance.

John Sweeny of Avemco says the whole insurance market for homebuilts should open up with Avemco taking on EAA and vice versa. He can be reached at 1‑800‑638‑8440. At present there are few catagories for insuring these aircraft. Rates go down when pilot has 300 hours, 500 hours, 1000 hours. Liability to others, not passenger is quoted at $250‑$350 per year. Liability to back seater: $500‑600. Hull insurance is available only for the original builder if he repairs it he will be paid $7.50 per verified hour, the hours limited to a formula for each component. Avemco insures from Sign off, excluding occupants. The hull may be insured after 5 hours with 10 Full stop landings. Contact for quotes on full flight (500,000/50,000)=$2663/yr. Exclude passenger an hull: $243/yr. With passenger and no hull: $506/yr. A $30,000 declared hull value = $1065 with $300 deductable. (add liability).

Exclusions include limit to named pilots only. must be current medical and biannual when policy written. No coverage for hand propping without a mechanic or pilot at the controls. No aerobatic flight.

Family endorsements includ limit of 25% for wife, 12.5% for children or parents. Medical coverage goes to $5,000.

One Source: Russ: 1‑800‑247‑7526.

CS' Herb Sanders likes Int'l Aerobatic Club through the Forest Agency at 312‑386‑0011 which gives him protection at aerobatic meets and regular BI and PD to $1,000,000 and $50,000 passenger coverage for $445/yr

**Security:**

Let's Face it, Insurance won't replace a homebuilt aircraft that is stolen. According to Light Plane Maintenance, Throttle Locks aren't much use. They suggest an opaque sun screen to keep out prying eyes and a lock and chain over the propeller. The sun screen prevents avionics thefts some too. Of note, most of the covers seen on Long EZs at Jackpot could be simply lifted up for casual observance of the instruments.

shopping cart base.... Moving the EZ around without unlocking the canopy, raising the nose gear or straining to lift the canard. Or avoiding the disaster of having a stranger lift your nose and drop your plane on the winglets can be easily handled with a 4" high reject shopping cart cut off just above the bottom. Get all wheel casters, not the two fixed wheel design. Put a piece of carpet on the bottom cart rack and drop the old EZ nose skid down on the cart. Works like a charm, especially in shared hangers.

**First Flights:**

Give the SQ1 2 weeks notice.

Of course the best video from RAF is on first flights. Check local builders groups for a copy.

Ian Ayton points out that the taxi tests, while important, are perhaps more dangerous than the first flight‑maintain carefull aircraft control. The pitch is more sensitive than you may be useful, especially down pitch. George suggests not trying to get into the full stall landings you may do in other planes. Instead, let the plane fly on. Develop a checklist and have the gear warning system working. It is easy for something to interrupt a pattern and cause a gear up landing. One example: leaving the gear down for three patterns and pulling it up instead of down on the last. (It is always the last pattern.)

Dave Randall, sq 2, has the videotape on readying the LongEZ, checking it out then taxi and first flight test procedures. Borrow it at Sq2 meetings.

Library Item #59 on Helmets.

Library Item #38H on Testing your pitot/static.

#11/1,12/2 Club Photographers.

#11/2 We may get an "emergency"spare prop for club use in Sq. 1. (Great American has loaners for the cost of transport both way.)

#11/2 We are considering buying a parachute for first flights.

#11/2 Read on Helmets and fire suits.

#12/3 Don't use wheel pants on taxi tests.

ON84/6 For a survival kit list.

For article on first flight in a Varieze, see Library item #29A.

For an article on first flight in the remote Pacific see library item #29G. See the chapter on main gear on brakes. Be sure on wheel pants, particularly the Sanders pants, to remove them for more than one full stop landing per 1/2 hour. If you do heat up the brakes, take off the pants immediately and cool the main gear strut. Avoid water to brakes themselves, old flyers say they tend to contract explosively.

Melville says, during first flights, check rigging effects:

For pitch, elevators should be between 1/16" and 3/16" high, compared to your 0o point on your canard tips. To get it right, check these following in this order:

As ailerons are rigged "limp" on the ground, they often ride high in flight and this must be checked. If you can't see the ailerons, a second crewmember is necessary‑and therefore allowed. If tuning is needed, turn the aileron push rods 1 turn each side before each check flight until the ailerons are smoothly lined up in the wing.

13) Canard incidence should be checked at 6/10o nose up, by leveling the template when the fuselage is level.

Check the wing incidence for roll: a. by checking relative incidence of wings, 2. check relative incidence of the winglets (hope it isn't, it's hard to fix) and 3. Check elevator match, if not matched, elongate the connection hole attached to the control rod. AM85/6.

**Runnaway Ezpreventer**:

Central States has a one pager on a Pickel collapsable chock that can be retrieved when you are inside the cockpit after start and nose raising etc. Library Item # .

**MAINTENANCE AND REBUILDING**

CS' McKean has a quick reference maintenance chart, Library Item # .

AS85/3 The Kreidel's two year report makes good reading. At 600 hours they have had to do little maintenance. Their Lamb tires last about 125 hours. Their brakes 75 to 100 hours, even with heavy duty pads. Their nose wheel tires last about 125 to 200 hours. Notable problems: used wrong type hose in the engine compartment for vacuum pump. Wrong "P" lead Stakon connectors. Don't use the EGC turn coordinator, use rather Brittain or Astronautics DC. Watch out for oil cooler hoses rubbing together. At the end of the Cowl stiffener use pop rivets and cover end with 2 ply bid lapped onto the cowl.

See library item #42A,B & C for brake maintenance articles.

Both Ronneberg and CS' Robbins routed the oil breather line into the right exhaust pipe. This reduces back pressure and as a result lost oil? In may not be worth the effort per Ronneberg. Your prop still gets oily. Moving the exit out to a trailing edge gets rid of the oil all over the canopy.

Library Item #43S on the latest in Autogas research.

Library Item #47F on keeping the wet compass wet.

Library Item #65F on changing ELT batteries.

May83/2 ***Builder Hint***: plans page 21‑5, Don't use brass‑on‑brass valve‑get one with teflon so it doesn't tighten up. Latest information is that that doesn't solve it either so... The San Diegans suggest Teflon valve must be modified to remain "free" by disassembly and grinding away a portion of the spring to reduce the seating pressure that spring exerts‑grind a little and test. A Piper dealer has another for about 50cents.

CS' Jake Bach reports that because we rotate our carbs 90o to standard that we put the float in the wrong place for nose down operation. As a result, with full tanks, we can get a fuel leak out of the bowl because the float is not working. Melville and Bach simply remedy by shutting down with fuel selector instead of mixture.

Library Item #47?: MAINTAINING THE WET COMPASS, Light Plane Maintenance.

Library Item #55: HOW TO CHECK MAG TIMING; A PILOTS GUIDE, Light Plane Maint.

***Builder Hint***: Kreidel is experimenting with an Aviation Lube that costs $125/lb. Sq. 1 people may buy lb. and share. It has worked well in the brass fitting so far.(Sep 83).

Library Item #56: A PILOT'S GUIDE TO COMPRESSION TESTING: Light Plane Maint.

**Fouling:**

We pulled the plugs on an 0‑235L2C the other day after it was running rough. We had what appeared to be brown sugar fall out of the lower spark plug hole. It also caked the spark blug insulator.

We talked to Lycoming and confirmed that it was lead. We were told to look into the spark plug holes for a ring of lead and to carefully dislodge it and remove it. Lead usually disolves in lean operation. However, on the 0‑235 the engine needs to be operated at a higher idle 1100‑1200rpm to avoid fouling, unless you are taxiing too fast. See Lyc Service letter 195A. When shutting down, run it up to 1800rpm for a short while, then pull back gradually, as it goes through 1200rpm pull mixture. Don't idle in a descent if possible.

Why hadn't the "brown sugar" dissoved this time? According to Lyc, even a small amount of silica (dust is just as much silica as sand) combines with the lead and makes the lead harden. A slight leak in the air box from Carb heat or other unfiltered air on the intake gives either warm air which changes mixture needs or dust. An oil analysis will confirm this problem.

Don Lewis has retired from Lyc and is now working at Western Cylinder Overhaul (818‑786‑7772). See also his speech on videotape, Library Item 60L. At various speeches he has discussed the following points:

**Engine Oil:**

Today engine oils are very good. The fuel and oil combinations are important, they must be compatable. There is a service bulletin 388 on using XE2 and resultant Exhaust valve sticking. Don thinks Aeroshell may be the best in the business. If you can't find your oil away from home, don't mix brands‑instead top up with straight mineral based oil‑break‑in oil SAE30. Change it when you get home. Most people use too heavy an oil. The lighter you can use within the specs (use average day temp on the ground to decide) the better, the better it flows, the quicker it reaches dry areas when cold, it does run a little hotter. See Lyc document 1014 on recommended oil procedure. Do not use addatives except Lyc pre‑lube in cold weather‑LW1672.

**Break‑in:**

Use break in oil‑straigh mineral SAE30‑ only the first 25 hours. Run the engine 3 times for 5 minutes maximum at a time. On the last time bring the RPM up from idle.

**Autogas:**

Lyc says that if you use autofuel, unauthorized with Lyc despite STC, you should tear down the engine immediately. Service Bull. 368. Checking out fuel requires 5 to 10 years for it to be reliably tested.

**Oil Temp Thermostat:**

There has been a problem with a nut coming loose in the Oil temp thermostat; see Service Instruction 1423 on installing the nut with locktite.. If the part 75944 has no following L, the procedure needs to be done and the L added to the part number.

**Valve clearance:**

On 0‑235 the intake and exhaust valves sould be checked every 100 hours when engine temp 70‑90o Book says 7‑9/1000ths, better to use 10/1000ths. Check your valve stem to guide clearance at 1/2 of the TBO. If a valve is bad, throw out the hydrolic valve unit too. A stuck valve usually means a Bent Pushrod which usually means a broken tappet valve. Recent 0‑320 engines use the same valves for high and low octane engines.

**Fuel Pump**:

It is important to vent the fuel pump overboard, particularly in an updraft system. The Spring 86 Texas fire may be related to this. The vent takes care of a rupture of either of the redundant pump diaphrams or an oil leak through the pump to engine seal.

**Pistons:**

0‑235 K,L,M,N,P pistons have been known to crack off their skirts. With new pistons, Service Letter L213 of March86, the TBO of 2000 can be increased the next time to 2400hours.

**Lead:**

The 0‑235 is suceptable to leading, particularly on lower spark plugs. Don't idle around too much. Lean out, even when taxiing. You can always lead at 75% power or less anywhere. Best to lean to 75F below peak temp.

**Cooling:**

There are not a lot of good statistics on updraft cooling. The lower probes, for example may be 100oF below the temp of the upper valves. If you can cleanly mount upper plug thermocouple, they are better in this installation, but they are vulnerable to abuse, especially when hanging loose during a spark plug change. Try to keep all cylinders within 75oF of each other.

**Exhaust Flange**:

Leaks at flange are good cause of overheating. Lyc has an $8 blow out proof gasket if you can't get the regular ones to work. The usual cause is a non‑flat, non clean flange surface on exhause or engine.

**Scheduled Maintenance:**

See CS' McKean's quick reference maintenance chart, Library Item #

**Oil breather lines:**

Both Ronneberg and Harry Robbins of Central States have routed the oil breather line into the right exhaust pipe. This reduces back pressure and as a result oil loss! It may not be worth the effort per Ronneberg. Your prop still gets oily.

**Chrome Plating:**

It is a good thing to do when cylinder is beyond specification. Particularly good to prevent rust on a 50 hour per year, or less, engine. More care in rebuilding and good oil flow in break in is critical. The steel and Nitrited cylinder walls are about equal, despite the reputation in the field.

**Spark Gaps:**

Don't use spec. gap of .16th clearance, use no less than .17, .19 is very good. .22 is too wide.

**Superior Parts:**

There is a warranty letter concerning Lyc engines without Lyc parts. However, reputable dealers do use those parts too. Valves for both Lyc and Superior are made by the same vendor, Eaton.

Library item #43G: Don't Fuel Around, Plane & Pilot Feb86.

Library item #53B: Synthetic Oil, AV. Consumer Nov85.

Library item #53C: Petro‑Basics, on recommended oils, Aopa Pilot Jan86.

According to the Kreidels, they had a valve stick due to the use of Phillips XE2 oil. On checking, they find they are not unique in noticing this problem.

Brad of Pelican Aviation, recommends Gebhardt Barkhorn at Torrance airport for engine work 213‑539‑6441. Barkhorn is a "by the book only" mechanic. AM86/4

According to the Kreidels, they had a valve stick due to the use of Phillips XE2 oil. On checking, they find they are not unique in noticing this problem.

Library item# 67: High Altitude Flight‑ Sport Av Jan86.

For article AVOIDING GYRO GERIATRICS, library item #23. For article COMMON SENSE AVIONICS MAINTENANCE, library item #37. On tach repair for the beginner, library item #47.

For articles on tach repairs for the beginner, see library item #47.

On repair of Bendix starters see Library item #45.

Library Item #58 ALTERNATOR TROUBLESHOOTING: A PILOT'S GUIDE, Light Plane Maint.

On servicing the spark plugs, see library itme #46.

**Important:**

There is a slick mag service letter of 7‑83 (apparently the tip of the rotor can become loose. There is another on loose bearings.

Marvel Carb has a bad float kit which actually sinks, flooding your cowl‑watch how you put your new spring in when you do the fix‑ write FACET, Filter Products Division, 434 W. 12 mile road, Madison Heights, MI 48071.

On Slick Mag maintenance and overhaul manual, see library item #40.

ON83/7 Article on mag timing.

Joe Wright rebuilds C152 engines.

#10/1 Chuch Smithfield can increase engine performance 20% without decreasing engine life by balancing, cylinder head laminar flow enhancement, and "c.c.ing" the combustion chambers.

For article on Dry Vacuum Pumps, library item #22.

There is a good Light Plane Maintenance article on ENGINE BREAK IN AFTER TOP OVERHAUL, Library item #19.

AM84/3 read Kreidel hint on a different air filter.

For information on AMSOIL, talk to Sq 2 member Joe Magdaleno (213) 594‑3551. See Library item #53 for brochure. Melville feels there is nothing of long term benefit from special oils. Dick Kreidel has maintained a full set of Change Notices from Lycoming. You are the manufacturer of your aircraft, don't expect RAF to keep you up to date on engine component problems. For various Lycoming publications see library item #35.

Materials committee: Slick Mags have been subject to some arcing problems on earlier models, check to see that changes have been accomplished.

**IS THERE LIFE AFTER TBO**, Lycoming Operating Tips, Library item #32A.

Sq2 Library item #35 is set of Lycoming handouts and materials. According to the reference in the "owners manual" to using any accessory case on an 0‑235, you can bolt an 0‑320 case on an 0‑235 physically, but the oil passages are quite different and only the bolts are the same.

Slick mags may require work a 250 hour intervals, don't drive them unless you have checked this with the literature available from lycoming on the engines.

On Lycoming modifications to consider at rebuild time, see library item #32E on bigger domes to avoid leading up, 0‑320 valves‑which are infinitely more available than 0‑235 valves, chromed barrels and appropriate rings.

Videotape on Prop installation, care, rebuilding available.

Videotape on Mag rebuilding is available at Sq. 2.

Melville doesn't much like the specialty oils.

Melville suggests pulling the exhaust system to check the condition of the valve stems at least once per year.

JJ85/17‑20 See Paul Prout's discussion on PRC and Autogas.

JJ85/14‑16 Article on "Safety Record of the Rutan Canards".

See library item #63D How Can They Sue Me? Sport Av Nov85 (.10)

Library item #67L on abc's of tie downs.

Library item #67K on Voyager Chutes.

Lynn Burks speaks well of Coastal Aviation Cylinder Overhaul, 714‑736‑6452 at 1965 Aviation Rd., Corona CA 91720.

One builder has seen his lower cowl attach lip crumble due to vibration and oil soak, keep an eye out. IV271

One of our members just pointed out Desser Tire & Rubber Co, 6208 Alameda St. POBox 01736, Los Angeles CA 90001 for discount aircraft tires and tubes of all types. We get 5 x 4s and tubes for just over $20.00 a wheel when we buy in bulk, contact 213‑655‑8900 to get into next group.