COZY NEWSLETTER #89 Apr. 2005

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As of January 1, 2004 Aircraft Spruce purchased the intellectual property (copyrighted plans, Construction Manuals, Owner's Manuals, information kits, etc.) of Co-Z Development and since that date, Aircraft Spruce is the only one authorized to sell Cozy plans and Construction Manuals, info kits, etc., but Co-Z Development will continue to provide builder support for the Cozy airplanes.

The 3rd Edition Cozy Mark IV plans were updated with all changes and corrections through newsletter #73. Since then, there have been no changes or corrections of any significance, except for revised canard incidence template drawings 80-3 and 80-4. These revised drawings will be included with each new set of plans, and extra copies may be obtained from Aircraft Spruce by sending them a stamped, addressed envelope.

The Cozy newsletter will continue to be published by Co-Z Development. It contains any plans corrections or changes, builder hints, information and updates about our suppliers, shopping info, first flight reports, and other news of interest to builders. It is the principle means by which we communicate with builders and support their projects.

The latest copy of the newsletter and older copies of the newsletter, which we can no longer supply, are available on the Unofficial Cozy Web Page, http://www.cozybuilders.org/ and also on a CD available at Aircraft Spruce. We will continue to answer telephone calls whenever we are home and personal letters as well, but please enclose a stamped, self-addressed envelope if you expect a reply. We encourage newsletter input from builders (letters and pictures) which would be of interest to other builders.

"Cozy" and "Cozy Mark IV" are trade names of Co-Z Development and are the names given to airplanes built according to the plans and instructions of Co-Z Development. Just because you buy a set of Cozy or Cozy Mark IV plans, does not mean you have to build your airplane exactly according to plans. It is an experimental airplane and you can, in fact, make whatever changes you desire. But then you have a new, untested design, and shouldn't register or insure your airplane as a Cozy or a Cozy Mark IV.

AUTHORIZED SUPPLIERS

Authorized suppliers are those suppliers we selected because of their excellent reputation in the industry, whose parts and materials we proofed in our plans model and who agreed to supply the same parts and materials to our builders.

1) Basic Materials

Aircraft Spruce West	Aircraft Spruce East	Wicks Aircraft
Box 4000	452 Dividend Dr.	410 Pine St.
Corona, CA 92880	Peachtr City GA 30269	Highland IL 62249
(909)372-9555	(770)487-2310	(800)221-9425

2) Metal Parts	**3) Fiberglass Parts**
Brock Mfg. Co.	Feather Lite
11852 Western Ave.	1327 S State St,Arpt.
Stanton CA 90680	Ukiah, CA 95482
(714)898-4366	(707)462-2939
	(707)462-3424

4) Canopy & Windows	**5) Specialties**	**6) Exhaust Systems**
Airplane Plastics Co.	B & C Spec.	Custom Aircraft
9785 Julie Court	PO Box B	14374 Olde Hwy 80
Tipp City, OH 45371	Newton KS67114	El Cajon CA 92021
(937) 669-2677	(316)283-8662	(800)561-1901

7) Propellors		**8) Prop Hub Exten.**
Performance Props	Sensenich Props	Saber Mfg.
Box 486	2008 Wood Ct.	3601 Nassau Ct.
Patagonia AZ 85624	Plant City FL33567	Granbury TX 76049
(520)394-2059	(813)752-3711	(817) 326-6293

OTHER PARTS WE RECOMMEND:

We can recommend the following items:

1) **New and rebuilt Lycoming engines.** Aerosport Power, 2965 Airport Drive, Kamloops, B.C. V2B 7W6 Tel (250) 376-2955, Fax (250) 376-1995.
2) **Luggage pods.** Gary Hunter (Epoxy expert) writes. I have been providing baggage pods for Variezes and Long Ezs for a number of years now. A few people have ordered them for the COZY. The standard pod is 6.5 ft. long and 12" dia at the fattest section. I am currently working on a slightly larger pod that will look proportionally better on the COZY. They aren't much longer, but they are 1.5" larger in diameter along their entire length. That doesn't sound like much, but they are noticeably larger. They will hold a lot more duffel style baggage. Larger items, like golf bags, will fit much more easily. Incidently, for CG consideration, the tail section of the pod (24") is not used for carrying luggage. But long, light items, like snow skis, can be carried in the tail section. The pods have a fairly flat bottom, so skis can ride on the bottom, and baggage sits on top of them in the front section. I anticipate completion of the molds in a month or two. Gary gluegaru@earthlink.net.
3) **New TMX Engines.** Teledyne Mattituck Services, 410 Airway Drive, PO Box 1432, Mattituck, NY 11952, (800)624-6680.
4) Improved **Rudder pedals** for lay-down brake cylinders, adjustable both sides. Dennis Oelmann (319) 277-5996.
5) **Electric speed brake actuator kit.** Wayne Lanza (772) 664-8953; wlanza@bellsouth.net
6) **Switching and breaker panel**. Wayne Lanza (772) 664-8953, www.CompositeDesignInc.com.
7) **Fuel sight gages**. Vance Atkinson (817) 354-8064.
8) **Electric nose-lift.** Steve Wright (615) 373-8764.
9) **Electric nose-lift, Spring steel safety catch,** and improved **MKNG-6 and NG-6 Pivots** with tapered roller bearings. Jack Wilhelmson (843) 884-5061.
10) **Electric pitch trim**. Alex Strong (760) 254-3692.
11) **Rebuilt flight instruments**. Howard Francis (not a Cozy builder) (480) 820-0405.
12) **Antennas.** RST Jim Weir (530) 272-2203.
13) **Teflon & Stainless Hinge Pins Replacement.** Gary Hall (954)979-9494.

14) **Nosegear crank ratchets.** Bill Theeringer (805) 964-5453.
15) **Featherlite:** Their email address is: fthrlite@pacific.net Check there for latest prices.

PUBLICITY

Brian DeFord had a picture of his Cozy Mark IV in December 2004 Kitplanes, and March 2005 Sport Aviation. He is enjoying his airplane very much, and it is good to see another of our builders in the news. Let's get those pictures in, guys (and gals)! You should be very proud of your accomplishments.

ENGINES

The February 2005 issue of Sport Aviation had a nice article by an RV-7 builder, Tom Deutsch, describing his experience in building an XP-360 Superior engine. He explained that Surperior has 4 ways you can purchase an engine: 1) You can buy it fully assembled, 2) You can have it shipped to you as a box full of parts, 3) You can go to Dallas to observe your engine being built, or 4) You can go to Dallas to be instructed and supervised to build it yourself. He chose to do the latter.

He said he was very impressed with Superior's facilities, and personal. He was allowed to choose his own pistons and rods for perfect balance, and the entire process took him only 3 days. Superior is building their own state-of-the-art test cell, but it isn't done yet, so testing and run-in is presently farmed out. He went with his engine to Custom Airmotive in Tulsa for it to be tested and run-in. To conclude the break in, the engine was run at full power for 10 minutes on a dynamometer. The result was that at 2700 rpm it produced 188 horsepower! The operator said his XP-360 engine was 10 to 12 hp stronger than the factory Lycs he tests. It was the 9th XP-360 he had tested, and all of them ran smoother than their competitors. Tom said that building his own engine was one of the most satisfying parts of his project. He said that building your own engine at Superior is one of the best-kept secrets in the amateur-built market, and when the word gets out, he thinks Superior will be very busy. He impressed me!

BUILDER HINTS

1) **Extra M drawings.** Some builders have asked if they could buy additional copys of the M-drawings, to replace those they have cut up. Cozy builder Kenneth Knevel, an architech by profession, has arranged to supply Aircraft Spruce with extra copies. The neat thing is that he has joined the drawings together so that the bulkheads, jigs, templates and fuselage cross-sections are in one piece and no longer need to be pieced together. Order P/N 01-00570 from AS for $49.95.
2) **Teflon coated wire:** Nick Ugolini says you can buy all kinds of shielded and unshielded Teflon coated wire (MIL spec) from http://www.skycraftsurplus.com, and that the prices are super good, too.
3) **Epoxy allergy:** Larry Capps says that the epoxy hardner causes many of the allergies you expect from epoxy. He says you can neutralize it by rinsing-off with "white vinegar", which changes the chemical structure to a water-soluble compound. Then you can cleanse you skin by washing off with soap and water. He reminds us that two prime sources for allergies come from the powder found in some gloves, and in latex gloves themselves.
4) **Nitrile gloves.** A sales flyer from Harbor Freight lists nitrile gloves at $6.99 for 100.
5) **Jacking up your airplane to change tires?** John Slade suggests lowering the nose to the floor, putting a padded support under one wing spar about 4 ft from the tip, and then flipping the nosegear down switch and watch the wheel come off the floor.
6) **Seat cushions.** Jack Wilhelmson reports that he bought a King size "temper foam" pad for $83 including shipping from www.Overstock.com. Since they only have a Queen size bed, he cut off the excess to use in his Cozy seats. The price is the same for Queen or King size. The density is about 4 lbs per cu ft.
7) **Seat covers.** Nothing can beat sheepskin for comfort. By far the best deal is sheepskin seat covers at an auto store, like Pep Boys. With a slight alteration, they work just fine. Both authentic and imitation covers are available.

CANARD CROSS-WIND LANDINGS

One of our new builders, Todd Parker (not flying yet) said on the internet that he heard that canard airplanes might be difficult to land and control in a crosswind, and suggested some changes. He was also critical of the landing brake.
Here are some of the responses he got:

Burrall Sanders writes on 3/2/05:

I wonder who says they are weak in crosswinds? In my opinion, they are one of the best planes ever for crosswind landings. The large rudders are very powerful, even at low airspeeds. The manually operated landing brake might be a little awkward to operate, which is easily remedied by an electric actuator.

Curt Smith writes on 3/2/05:

With 1000 flight hours over the past 20 years in Rutan designs (including my Cozy Mark IV), I've never experienced a crosswind control or speed brake problem, so I wonder what experience or "complaint" spurred this. Sounds like another "solution" to a non-existent problem.

Paul Krasa writes on 3/2/05:

The EZ series of airplanes in which I include the Cozys, is one of the best crosswind airplanes I have ever flown. It is better than a Cessna, Mooney, or Piper in a strong gusty crosswind. I have landed my EZ in a 25 gusting to 40 kt crosswind at 45 degrees to the runway. If you don't know how to crab the airplane down final I might understand the issue, but even slipping into the wind, the EZ does fine. Not quite sure where you are getting your information from. My advice is to build the airplane to plans and you will be happy with the flying qualities. Every modification will increase your build time significantly, and could compromise the safety of the airplane.

David Teter writes on 3/2/05:

I don't have near the experience that many of you do. I'm only pushing 400 hours of flight experience, with the last 300 all in canards. My first was a Long EZ, followed by a Velocity, and now flying a Varieze. All were per plans aircraft. The Varieze has vg's and trailing edge fences. I would take any of these aircraft in a crosswind situation over anything else I have ever flown. Cessnas, Piper, Tigers, etc. Build per plans, learn the flight characteristics of your plane, know its limitations (and yours) and fly the plane!

Ken Miller writes on 3/2/05:

Todd, with all due respect, you should get a lot more time in a Cozy or Long. You will find that they have few, if any, shortcomings, especially in crosswinds. You have found through all the responses, that the complexity and weight involved (in making the changes you suggest) is not worth the result. All of us that have many, many hours in the design know this. Your time could be better spent out in your garage, building.

Editor: I also added my own comments after 27 years flying canard airplanes.

NOSEWHEEL STEERING – A GOOD IDEA?

The nosewheel on the Cozy Mark IV is designed with an improved shimmy damper. Although in one sense, the nose wheel is free-swiveling, the shimmy damper sort of locks it in position, such that a certain break-away force is required to make it swivel. The break away force is set by the pilot. What this means is that in taxiing and take off, the airplane tries to travel in a straight line. If that straight line does not line up with the taxiway or runway, a tap on one brake will cause the wheel (and the airplane) to take a new direction. You can set the friction such that a mild cross wind has little or no affect on direction of travel. If a correction is needed, just a tap on the brake is sufficient. It should not be necessary to hold continuous pressure on the brake. Just tapping it as necessary is sufficient. The beauty of the system is that both the brake and the rudder are operated by the same pedal. However, you don't get braking until the rudder is fully deployed. So even in a strong cross wind, after you have gained certain amount of forward speed, you only need rudder to compensate for the sideward force of the cross wind, and you do not press the rudder pedal hard enough to engage any braking force. If you find that you need continuous brake pressure to taxi in a cross wind, increasing the friction on the shimmy damper would correct the problem. You might say that this design combines the advantages of both free-swiveling and lockable nose wheel, seems to work almost to everyone's satisfaction, and negates any incentive to make the system any more complicated and expensive (and problem-prone). It is in keeping with the KISS principle.

You might wonder if the nosewheel is ever turned to one side after lift off, such that you couldn't retract it into the nosewheel well. This has never happened to me nor have I ever heard of it happening to anyone else. You might say it is a near physical impossibility. Maybe this will explain why we encourage builders to build it the way it is designed, and then if they still think there is a problem, define what the problem is and then try to find the simplest solution.

WINGLETS

There are some very knowledgeable aerodynamicists in Marc Zeitlin's internet discussion group. As builders were postulating about the function of Whitcomb winglets, Matt Overholt referred to a posting Andy Amendala made to the Canard-Aviators list on 9-18-2003, and Dan Davidson re-published it on 2/17/05. What Andy explained for the Long EZ applies equally to the Cozy III and Cozy Mark IV.

Andy writes on 9/18/03:

"Greetings John - I figured I would take the time to educate you on some of the functions the winglets perform and how they do so. I'm not sure what you know about aerodynamics, so if I sound like I'm patronizing your knowledge, please don't take it that way, I simply wish to inform. I thought you'd be surprised to find out just how much those giant fins you have on your Long EZ are doing out there.

"First off, let me say that you are 100% correct in your assumptions about the forces applied to the wing structure on the whole. The resultant forces of the winglets do resolve to a tension in the high-pressure surface of the wing (the lower side obviously), and of course if we're in tension on the bottom side, the top side of the structure must be feeling some compressive load. I'll give you an explanation of why this is the case and the function of the winglets as a whole. I'll try to be as detailed as I can, but keep it relatively simple as well.

"First and foremost, the reason the wing feels those forces is simply because the winglets on the Long EZ produce lift. In fact, they produce a tremendous amount of it. I haven't done the precise lift calculations but cursory calculations indicate right off that you'd have a hard time accelerating your Long EZ on the ground to a high enough speed to even lift off if you had a symmetric airfoil on the winglet (as opposed to the lifting airfoil we have). So the winglets on the Long EZ pull inward toward the fuselage really hard. Much harder than you might imagine. Take notice of the substantial amount of glass applied when attaching them to the wing.

"So let's get technical… Why all this force pulling inwards from the creation of lift? Why do we have these structures as opposed to just a longer main wing? Why are they angled inwards toward the wing? Why are they canted toward the nose? And so on.

"The higher pressure air under a wing wants to spill around the wingtip to try to fill in the low pressure area on top of the wing. This flow results in a tip vortex trailing aft from the wingtip, like a horizontal tornado. You can see these vortices at the wingtips of a jet fighter dring a high-lift maneuver in sufficiently humid air, or at the tips of an airliner's flaps during a landing approach in wet weather. The energy extracted continuously from the aircraft to make the air swirl like that is a direct result of the creation of lift and is dubbed 'induced drag'. These vortices are at their worst when we're trying to make lots of lift with relatively little airflow. This means that slow flight (low speed, low mass flow, high lift coefficient) is one of the worst cases. This also means that the intensity of the tip vortices will be highest at these kinds of flight conditions. The higher the intensity of these vortices, the higher the induced drag on the aircraft, and thus, a greater amount of wasted energy. If you trace back how your airplane is really flying, you get to one source of energy, the fuel in your tanks. Extracting every ounce of energy from that fuel in every respect is a challenge of aircraft design. So the more energy we waste on things like wingtip drag, the less energy for the airplane to use for other means. I won't go into it here, but you can read about a coefficient that you can calculate that will tell you in general how efficient your aircraft is… this is known as the Oswald Efficiency Factor.

"So back to winglets specifically, there are generally two families of winglets you'll find on aircraft today. Simply put, lacking many specifics of course, one family has the production of lift as one of its primary jobs, and the other does not. The winglet style on the Long EZ is of the lift-producing family, and was designed by Richard T. Whitcomb. Our winglets are hence called Whitcomb Winglets. A small historical fact, the first aircraft to ever fly with these winglets was Varieze N4EZ.

"So, we need to talk about "helix angle". If you understand the pitch of a prop, you're already familiar with it. Helix angle is one way to measure how far something rotates compared to how far it travels forward in the same time. The blade angle of a propeller blade is nearly the same (minus its efficiency effects and local angle of attack) as its helix angle. A wingtip vortex has a helix angle as well. This angle will be nearly parallel to the airplane's direction of flight when induced drag is low, but twist up into increasingly greater angles relative to the flight direction as we slow down or pull more gs.

"If we have a significant amount of induced drag, and a correspondingly stronger tip vortex, then the flow at the wingtip will not be parallel to it, but rather at an inward angle on the top and an outward angle on the bottom. This is where the winglets come in.

"If we park a lifting surface in the middle of this angled air flow, it will develop lift perpendicular to the angled air flow. The resulting lift will be angled forward, and the forward component of that lift will be producing thrust. The lifting surface (the winglet) will also be producing drag of its own, including both parasite and induced drag. So essentially, the winglets on the Long EZ are producing lift, not only due to their high-pressure-on-the outside airfoil, but also due to the energy they are harnessing from the tip vortices. So the winglets, being an effective wall in the middle of the tip vortices, don't just waste the energy there, they utilize it for lift and thrust and in the end, you have a highly diminished vortex trailing behind the aircraft and that means lower induced drag at the tips.

"But recall I said that the winglet makes drag of its own too… If the drag the winglet produces is less than the forward component of its lift, then there will be a net thrust applied from the winglet to the aircraft. Yes, our LongEZ winglets actually provide some thrust to the aircraft! This thrust actually represents some of the energy in the tip vortex, harvested from the vortex by the winglet and given back to the aircraft. That's it. That's all there is to it, quite simple really.

"Ok, now the catch…. How do we maximize that thrust? This is where it gets complicated. Let me quickly define a couple of geometry terms I'll refer to. When I say "toe-in", I'm referring to the angle of the leading edge of the winglet with respect to the absolute tip of the Long EZ's nose. So if you stared at the winglets from the FRONT of the airplane, the more of the "outside" of the winglet you can see, the greater the toe-in angle. I'll also refer to winglet "cant". The "cant" I'm referring to is the tilt inwards of the winglets toward the wing. If you look at a Long EZ, you'll notice its winglets tilt inwards slightly (the top of the winglets point toward each other).

"If you increase the angle of attack of the winglet by increasing the toe-in angle, then it makes more lift force (which should theoretically increase the forward component of that lift), but it also makes more drag of course. Depending on the specific situation, this could increase, decrease, or not change the net thrust of the winglet. It's going to depend on a lot of factors, including the flight condition.

"The last item is particularly critical. Because the amount of induced drag and the helix angle of the vortex decrease as you increase airspeed, the energy available for "harvesting" by the winglet decreases as you fly faster. Meanwhile, the parasite drag of the winglet is increasing. Eventually you get to a point where the total drag of the winglet is equal to the forward component of its lift, and at that point the winglet produces zero thrust. This is called the "crossover velocity". At airspeeds higher than the crossover velocity, the winglet adds to the aircraft's total drag and you'd be better off without it.

"Thankfully, we don't have to worry about most of this with the Long EZ since the aircraft is already superbly aerodynamically engineered. I just thought you'd find it informative. So I covered why the high pressure side is on the outside, and what the toe-in does for lift, but what about twist and cant?

"The process of "unwinding" the tip vortex that the winglets perform is accomplished both because they are a physical wall in the way of the vortex, but also due to the effective aerodynamic twist of the airfoil. The orientation of the upper and lower winglets provide effective aerodynamic twist to assist in this function. I"l leave this alone unless you desire details.

"As far as the "inward-cant" of the winglets is concerned, when you think about it, you might think they're detrimental to the design to some degree. If lift is created perpendicular to the airfoil body, and the winglets on the Long EZ are canted slightly inwards, don't we end up with a slight portion of that lift pointing towards the ground (i.e.adding to the weight of the aircraft? Yes, we do. However, it is entirely negligible, it's that small. Burt ran me through some quick calculations a ways back just to show me how negligible it is. So why do they point inwards at all then? They reduce the effective dihedral of the wing.

"You know of course that the Long EZ main wings have sweep to them and, duh, they have winglets. Adding wing sweep and a winglet to a wing both make the wing feel as if it has dihedral. Since they don't actually have dihedral physically, we call it 'effective dihedral'. When Burt designed the Long EZ with a larger wing, he needed wingtip clearance for crosswind landings. Because of this, he needed to do away with the anhedral design of the Varieze. Think of the consequence… The Varieze's effective dihedral from both adding the winglet and from sweeping the wing is counteracted by the anhedral in the main wing surface. Reducing this anhedral to zero, as was done on the Long EZ for tip clearance, would obviously bring the effective dihedral back up and make the craft more stable, however, more difficult to turn. So to reduce this effect as much as possible, Burt canted the winglets on the Long EZ inward slightly.

"So now you can run off and think about all that's happening out there on those fins. I think I've dragged you on long enough, but think about how the rudders on the Long EZ might work given your knowledge of winglets now. They function differently than conventional rudders. Also think about what happens to roll rate if you cant the winglets outward instead of inward. Think about how changing the toe-in angle would seriously change things. Also think about my favorite modification that I still fail to agree with—cutting off the lower winglets.

"If you think about what all those changes do, you'll better understand the function and design of the winglet. If you've got any questions, write me back privately. I'd be happy to respond however I can. Safe flying!"

Andy Amendala, Long EZ.

Editorial Comment:

Andy Amendala obviously has spent some time discussing the Long EZ design with Burt Rutan, and we thank him for stating all these characteristics and considerations so clearly in his post awhile back. We thank Matt Overholdt for calling them to our attention, and Dan Davidson for republishing them.

There are several things worth adding:

1) Normally the tips of the wings on airplanes are ineffective in generating lift, because the same swirling motion that creates the tip vortex neutralizes the differential pressure between the bottom and top of the wings. The addition of winglets increases the effective wingspan by 2/3rds the height of the winglet. This is very important in a canard airplane with swept wings because the most effective lift (in preventing a main wing stall) is at the tips.
2) In our aft c.g. flight testing, we demonstrated that the lower winglets not only provide lateral stability at high angles of attack, but also increase the c.g. range by ½ inch. This means that they contribute to the lift at the wing tips, which is the most important lift in preventing main wing stall.
3) Because the winglets generate some thrust, this overcomes the drag, so (per Burt) you get directional stability for free.
4) Placing the rudders in the winglets makes them unusually effective because they are so far removed from the c.g.; i.e. they operate at a very long leverage arm.
5) The rudders are also unusually effective because only the one on the inside of the turn is used. The added drag it creates when it is deflected outward slows down that wing, causing it to lose some lift and drop, which helps the airplane turn and avoids the yaw that accompanies many airplanes starting a turn.

All of the above are indicative of the absolute genius of Burt Rutan, and should give pause for anyone thinking he (or she) could improve the design by changing any of the aerodynamic relationships.

CANARD VS MAIN WING

Some builders are tempted to increase the span of the canard so they can carry more weight in the front seat, but there is a definite relationship between the canard and the main wing that should not be ignored. The canard is not flying all by itself in a separate world. It is attached to an airplane that also has a main wing, and that main wing is following the canard wherever it goes. It is a known fact that the air over a lifting surface is deflected downward, and that the air passing beyond the tips of a lifting surface is deflected upward. That is what causes the wing tip vortex on airplanes without winglets. And we know you shouldn't fly behind a "heavy" that is taking off or landing, because the greatest vortex is generated by high angles of attack. No, you have the interesting situation with a canard aircraft that a part of the wing is always flying in the downwash of the canard, and the outer portion of the wing is flying in the upwash. This has the affect of decreasing the incidence of the wing behind the canard, and increasing the incidence of the wing outboard of the canard, and this affect is greatest at high angles of attack.

The most valuable lift from the main wings is out near the tips, because with the sweep of the wings, that lift is farther aft and it provides the nose down authority for positive stability. The is one reason why the lower winglets are so valuable, because they fence in the hig pressure air near the tip and prevent loss of lift there from a vortex that normally occurs at the tip.

We have seen what a powerful affect on stability results from just decreasing the span of the canard a little When we removed just 3 inches from each tip of the canard, it moved the main wing stall c.g. point aft more than 1.1 inches. Have you ever wondered why? Well, if you increase the canard span just a little, you reduce the wing loading on the canard and allow it to go to a higher angle of attack before it stalls, or reaches it's highest coefficient of lift. But at the same time, you are putting more of the main wing in the down wash of the canard, so you are also losing lift from the inboard portion of the main wing, and increasing the wing loading on the outer portion of the wing. So increasing the span of the canard has a double negative affect on stability—it allows the canard to go to a higher angle of attack, and it reduces the angle of attack of the main wing stall—a double whammy!! That is why we strongly recommend that builders DO NOT increase the span of their canards.

FUSELAGE WIDTH

When one is building from plans, it is very easy to make design changes. So some builders think it would be very nice to increase the fuselage width 2 or 4 or 6 inches (there was even a case where someone increased the width by 12 inches). What they don't realize is that the fuselage is a "lifting" body, which makes a significant contribution to total lift, and even more important, the fuselage lift is DESTABILIZING! It is destabilizing because it is ahead of the c.g., and it does not stall like the canard does at 14 degrees, so it generates more lift the higher the nose goes. What this means is that increasing the width of the fuselage will move the c.g. at which the main wing stalls forward. Without having any concept of the consequences, the same builders think that they should also increase the span of the canard when they widen the fuselage. Again, a double (maybe tripple) whammy!

The design of a successful canard aircraft is a very sensitive balancing act, and changes by unknowledgeable builders can be very perilous.

FUEL TANK TESTING

One of our builders asked other builders on the internet about their experience in testing for fuel tank leaks. Here are a couple of good responses he received:

Ken Miller writes on 3/2/05:

I use an airspeed indicator. Seal the tank, then use a vacuum hose from the auto parts store to connect the indicator to your vent line. Put another hose on the line to the engine. Using your lungs only, blow on the hose until you see 100 mph on the ASI, or 90 kts. Crimp or fold the line, and clamp with a spring clamp. If the indicator begins to drop, then you will need to start spraying everywhere you can get to with a mixture of liquid dish soap and water.

If you have a leak that can't be found with the soapy water, then you may need to go with the freon sniffer. You would introduce the freon carefully into the tank where you blew on the line before. It is also a good idea to suck on the hose to evacuate the tank a little before inflating it with the freon. Be very careful, because too much pressure can destroy your tanks. If you do find a leak, then use a vacuum to suck warm epoxy into the crack. After you are sure that the leak has been filled, remove the vacuum and allow the epoxy to cure. Again, be careful not to collapse the tank.

Burrall Sanders writes on 3/2/05:

Your tanks are probably ok if they are still holding pressure after 24 hours. I have scratch built four pairs of strakes and have had one tank leak and it showed up within an hour. It was an interesting leak. I did as Ken Miller just suggested in an earlier post today. I used soapy water to find bubbles. Looked and looked and could not find the source. I checked hard lines, fuel valve, changed airspeed indicator and everything else I could think of. Imagine my surprise when I found bubbles in the soap when I brushed it on the aft end of the longerons!! The air was migrating through the wood grain. It was a Cozy III that used sump blisters like the Long EZ and I had failed to properly seal around the engine mount extrusion bolts that go through the longerons in the sump. The air was going under the bolt head into the wood grain and then going length-wise with the grain. I simply had to cut off the sump and seal around the bolt.

Keep in mind that temperature has a large effect on the balloon (if you use one) or the airspeed indicator. I was fooled once into thinking I had a leak when I went back to the shop the next morning to find I had lost most all airspeed indication. I went away all disappointed thinking I was going to have to chase leaks. The next day I returned in the afternoon to find that I had 100 mph in the tanks again. Then it dawned on me that the cooling and heating of the day and night were causing my confusion.

FUEL TANK VENTING

There are several reasons to vent fuel tanks, and they are related. The first is to allow for the expansion of air and fuel in the tanks, as the airplane sits in the sun. The second is to allow air to replace the fuel as it is consumed by the engine, and the third is to add a little pressure to the tank while flying to help deliver fuel to the engine. So what is the best way to accomplish all three?

If you build your strakes/tanks per plans, the highest point of the tanks, when parked nose down, will be the rear inboard corner. That is where you should locate the vent, or at least drill a hole in the vent line there, so fuel will not be forced out of the vent while parked. The filler cap is farther forward and at a lower elevation when parked, so even if you fill your tanks, there should always be some air in your tanks above the level of fuel at that location of the vent line. We recommend that the vent line run up to the top of the firewall, and then down the other side, so that it would take a maximum amount of air pressure in the tank to force the fuel up that high, and also as a safety precaution if your airplane is ever turned upside down in a landing or if you ever fly upside down (not recommended) to prevent fuel from running out of your tanks.

Any kind of a vent will allow air to replace fuel consumed by the engine, as long as the vent does not draw a vacuum on the tank by facing the wrong way.

By facing the vent into the relative wind, the velocity head will pressurize the tank when flying, and assist the fuel pump in delivering fuel to the engine.

So why do some airplanes vent fuel when sitting in the sun or when flying? The fuel tanks are insulated with foam, so they do not heat much in the sun. However if the vent is not in the highest part of the tank, the air could heat slightly, expand, and force fuel out of a submerged vent.

While flying, it should not be possible to raise the nose high enough, for any appreciable length of time, to cause the level of fuel to be higher than the top of the firewall, so that should not cause fuel to vent. However, at rotation, without a lot of velocity head air pressure exerted on the tanks through the vent line, and with full tanks, the sudden raising of the nose could cause the fuel to surge to the rear, and just the momentum of the fuel could force a little fuel up the vent line, over the top of the firewall, and out the vent. If this happens, the dye in the fuel could leave a stain on the underside of your cowling.

So, the bottom line is: Install the vent so you are venting the highest part of the tank (the inboard rear corner) while parked; run the vent line over the top of the firewall and down the other side; have the vent line face forward into the relative wind while flying; do not fill your tanks early in the morning before sitting all day in the hot sun; do not try to over fill your tanks by filling them with the airplane level; and do not jerk your airplane off the ground at minimum airspeed and maximum angle of attack.

SAFETY & FUEL MANAGEMENT

There is no way that we know of to prevent some people from running out of fuel, no matter how many gages, totalizers, etc. that they have. Here are some thoughts:

1) We only have sight glasses (the KISS principle). We load our airplane so that the sight glasses are not obstructed. We fasten our luggage down with safety belts. We use bright orange soft luggage (easy to see from a distance). We have a pocket size ELT that can be removed from the airplane and carried in a pocket.
2) If one sight glass is hard to see, we use from that tank first.
3) We always fuel up (full) just before starting a long trip.
4) We have locking caps on our tanks. They don't leak in rain. It takes a key to open and pull out the cap, and you can't remove the key until the cap is back in place and locked. The fuel key is on the same ring as our ignition key, so we can't start the engine until the caps are locked in place.
5) We keep track of time in the air and distance flown. We can cruise for 5 hours (2-1/2 hours per tank) between refills. That takes us from Phoenix to McCook Nebraska, or from Phoenix to College Station Texas (at the Louisiana border) with a reserve.
6) We have a grounding chain attached to the fuel cap, and bond from the cap to the hose nozzle before inserting it into the tank to prevent fueling fires.
7) We fly at 2450 – 2500 rpm with the engine leaned lean of peak, and this gives us 185-190 mph TAS at approx 8.5 gph (We still have magnetos and an Ellison TB).
8) We have one battery (only one) and we know our engine will keep running if that battery is dead.
9) We know we can run a tank dry and the engine will restart the instant we switch tanks. We don't do this on purpose, but it has happened twice in 22 years.
10) We fly high (9,000 to 14,000 ft) most of the time, and switch tanks only when we are over airports or within gliding distance.
11) I have a substantial survival knife along side my seat cushion that has one saw tooth edtge Although I have never tried it, I am reasonably sure I could cut my way through the canopy.
12) We always carry a bottle of water and a spare tire.

At our age, we don't want to take any chances. Hope this helps—it works for us !

PARACHUTE FOR FLIGHT TESTING

A builder asked if anyone carries a parachute with them when they do the initial test flights for the first 40 hours:

Keith Spreuer responded on 2/2/05:

This question was asked about a year ago when I was getting ready for test. The general consensus was that in almost any case you're safer staying with the airplane (in the case of a Cozy). The canopy would be very difficult to open and get clear of. Then if you go over the strake you would hit the prop. If you go under, you hit the gear. The airframe has been tested many many times. The odds of a structural problem are very low, given you have inspected carefully and followed the plans carefully. The most common first flight problems are power loss. This can be due to a fuel problem, over temps, oil or ignition to name a few. For power loss and for most other common failure in the flight tests, the best solution is make a controlled landing. If you're smart (read that as smarter than me) you will be within gliding distance of an airport, as landing a Cozy off field is highly undesireable, although survivable if relatively smooth and hard. I didn't, and most don't wear a chute.

Editorial comment: When we did our aft c.g. testing, to determine stall resistance, we carried a chute, but we were doing the testing at 11,000 ft, and purposely trying to stall the airplane. We had a moving weight to change the c.g. in flight, if we entered a stall and could not recover with just control input. Also, the accounts we had read about the Velocity main wing stalls, was that main wing stalls caused the airplane to mush in an almost level attitude, and one pilot was able to open the canopy and crawl out on the canard. Had he chosen to jump, he probably could have made it successfully, but instead he chose to splash down on the water (he was over the ocean).

WANT MORE HEAT?

The plans instruct you to install a shroud around #4 (the longest) and #2 pipes, because one pipe does not generate enough heat. The higher pressure in the lower part of the cowling (up-draft cooling) will push the hot air forward. If you want more airflow, Carl Denk reports that Globe motor makes a 3" dia. less than 3" long tube axial blower that is high pressure, high volume, temperature tolerant, and reasonably priced. He said his works well, and doing practice approaches with surface temps around freezing, he was in his shirt sleeves, no jacket.

FOR SALE

1) Dennis Oelmann (a master builder) writes: 11/15/04

I have a set of wings match drilled to a main spar and a Roncz canard for sale. The wings have the ailerons and rudders cut out and mounted. The canard has the elevators mounted and tips on. All parts are per plans. If anyone is interested in these parts to further their project, please email me privately for details. Thanks. Dennis. FLYCOZY@AOL.COM. (319)231-2635

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