Two Thousand Ways to Fly A Canard

Suggestions from Experienced Southern California EZ Squadron Members
Resulting From A Century and a Half of Combined EZ Flying Experience.
Primarily for Non-Builders

Dedication

To Burt Rutan, who resides in Mecca, spelled M-O-J-A-V-E.
Burt, thanks from all of us who appreciate your putting the fun back into flying.

Century Contributors

First Flew A Canard

Chuck Busch	1982	Builder - Long-EZ
Ed Esteb	1987	Builder - Long-EZ
Jerry Hansen	1983	Builder - Long-EZ
Al Hodges	1989	Bought - Long-EZ
David Orr	1988	Builder - Long-EZ
Dan Patch	1981	Builder - Vari-eze
Ed Sammons	1986	Bought - Long-EZ
Sid Tolchin	1987	Builder - Long-EZ, Bought Vari-eze
Terry Yake		

At publication (2004), these pilots have combined canard flying experience of over 150 years!

Note: Not one of these pilots agrees with all the methods and concepts presented.

You can always tell a pilot; but you can't tell him much!

DISCLAIMER

Any information provided in this document is for information purposes only and is not to be construed as flight instruction by any interpretation. Any of these maneuvers you may attempt during flight are your sole responsibility and/or the responsibility of your flight instructor. The pilots making contributions to this collection shall be held without fault or any responsibility by the pilot and his heirs should any accident or incident occur during your operation of an aircraft.

Two Thousand Ways to Fly A Canard

Tips From A Century and a Half of Combined EZ Flying Experience

Pilots' Creed — *The pilot is the highest form of life on earth.*

With more than two thousand homebuilt, canard aircraft flying today, there are over two thousand ways to fly a canard. Experimental aircraft are all unique, and so are their pilots. The reason for writing down some tips from a group of pilots with over a century and a half of combined canard flying experience is to provide the many new pilots of canard aircraft a basis for starting to learn. Most of us did not receive any dual instruction in a canard aircraft. Canard aircraft are forgiving aircraft, making transition easier for all of us. Building a composite aircraft may not teach you to fly the aircraft, but it does give you many, many years to learn from other canard pilots during the building process. Pilots, who purchase a completed aircraft, do not have this advantage, and there is a learning curve for the new Experimental pilot. Burt Rutan stopped selling plans over fifteen years ago, so many new canard pilots are buying aircraft, not building them. These suggestions are provided to ease transition and reduce the need for luck while learning.

I purchased my Long-EZ and flew it solo after paying the money to take my chances. The builder took me up to learn to use the stick, but without rudders in the back seat, the learning experience was very poor. A couple efforts to land the plane on a cloud and osmosis were the extent of my flight training lessons in the EZ. It was not enough. After I took off from the seller's airport to go to Tamiami (TMB) in Miami, Florida, I had about fifteen minutes to learn to fly the plane from the front seat. On a busy, busy Saturday afternoon at one of America's busiest General Aviation airports, I did land the plane on a 5,000 feet runway, but not until I made two inglorious aborted landings. The tower was not pleased. I did not feel comfortable until I had over fifteen hours of self-training in the Long-EZ. Only then would I permit anyone to ride as a passenger.

Ed offers his view as a CFII. "I refuse to give flight instruction in an airplane I cannot control. An eze without rear controls does not qualify for dual instruction"

When I purchased my Long-EZ, I knew nothing about composite construction and aircraft maintenance. This has changed, from necessity. Another Vari-eze and Long-EZ owner says, "I have found that an important issue here is that, builder or not, the pilot (pilot/owner) should become very interested in all facets of the structure. My pre-owned Vari-eze proves this point to me many times compared to my Long-EZ that was built by Ed Esteb and Bill Hargis and me (with the canard community heavily involved). There are "quirks" of the builder that can be discovered only if the pilot delves into the innards. I'm not advocating changes or modifications necessarily, I am advocating knowledge about the workings, observation for weak points, areas of wear, needs for lubrication or rewiring, checking for small oil or fuel or hydraulic leaks, etc. I cannot think of a single instance, on either the Vari or the Long, when I have removed the cowl, that I haven't noticed something that required a tweak, whether moving a wire or tie-wiring a bundle,

wiping a spot of oil or noting a telltale tiny streak of green, or tightening a bolt or nut, or using epoxy to fill a tiny nick in the prop."

During the fifteen years I have owned the Long-EZ, I have learned there are differences between canard aircraft and standard configuration aircraft. More importantly, I learned from personal experimentation and testing, from personal mistakes, and from experiences of other pilots. Willing eze pilots do contribute advice to make the world safer for new canard pilots. This document continues the practice of passing along information to help reduce risks, incidents, and repair expenses. Most pilots understand the need to keep on learning, and after over 56 years of flying, I am still learning.

How can an old, bold pilot live until 97?

Jimmy Doolittle, at 97 years of age

Use these suggestions with a lot of luck to delay the fateful day when:

Only two bad things can happen to a pilot, and one of them will:

a. One day, you will walk out to the aircraft knowing it is your last flight in an airplane, or
b. One day you will walk out to the aircraft not knowing it is your last flight in an airplane.

Canard aircraft buyers usually do not help build and test-fly the aircraft. But a canard aircraft buyer should follow the test flight procedures specified in the Owner's Handbook. Practice these maneuvers above 3,000 feet AGL. Almost certainly, you will need that empty space below you, sometime. Remember the pilot's old axiom:

The three most useless things in a pilot's life are:

1) The altitude above you,
2) The runway behind you, and
3) The gas you did not put in the tank.

Until you can prove that you can do it better, follow Burt Rutan's advice in the Handbook.

The canard provides 20% of the lift. Damage to the canard can reduce this lift to a dangerous level. When I encountered my personal "Sucker Hole" in 1992 (See Canard

Pusher-75, April 1993 on www.ez.org), hail destroyed the leading edge of my canard, reducing the laminar airflow. Only with full aft trim and heavy aft stick pressure could I maintain straight and level flight for two hours to reach Oshkosh. Burt Rutan’s comment was, “I would not high speed taxi that aircraft.”

Differences – Canard Pushers and Standard Configuration Tractor Aircraft

There are differences between operating canards and operating standard configuration aircraft. These differences – not problems, just differences – require learning new techniques for:

* Pre-Flight,
* Taxi,
* Take-off,
* Climb,
* Straight and level,
* Landing, and
* Maintenance.

Otherwise, canard aircraft are like any other aircraft.

Never feel sorry for a person who owns an airplane.

Alec Baldwin, the movie "The Edge"

Pre-Flight - loose screws and etc.

Pusher aircraft operate with an inherent risk not found in tractor aircraft. Pieces of metal, screws, exhaust valves, or other items that depart the aircraft may chip away part of the wooden propeller. I have replaced two wooden propellers for this reason during my fifteen years flying the Long-EZ. A broken valve broke off a piece of the propeller so large that resulting vibration made an immediate landing necessary! (See *Incomplete Trip to Tallahassee*, www.ez.org, *Articles*.)

Every pre-flight should include a check of the tightness of the cowling screws. As the years fly by, cowl removal to change oil, plugs, inspect, replace hoses, clean the engine and parts, and the myriad other reasons to remove and replace cowls result in less gripping power and the need to tighten the screws more than when the aircraft was new. The clutch on my power screwdriver is now set at three, whereas it used to be set at two.

Another canard pilot forgot to put any screws in the cowling. David Orr testifies that it is the quickest way to make 5” strips out of the cowls, but David denies being the guilty pilot!

Pre-Flight - Water in the fuel:

This is a good place to clear up an FAA old wives tale about water in the fuel tank. There used to be, and probably still is, a question on the FAA Private Pilot Written Exam

about the reason to fill fuel tanks after every flight. The FAA answer – and a wrong answer – is to prevent condensation of water in the tank as air cools.

Water in the fuel tank results from three possibilities and neither is from condensation of humidity inside the tank. They are:

1) Rain leaking around the fuel caps as the seals deteriorate,
   (The seals on my Long-EZ gas caps are “O” rings.),
2) Pumping fuel contaminated with water into the tank, and
3) Doubtful, but possible, from rain being blown into the fuel tank vents.

Obviously, you need to drain the fuel tanks prior to flight to remove water and contamination, just in case.

This conclusion is after parking a Long-EZ on the ramp in hot, humid, rainy Miami, Florida for twelve years. Condensation was so heavy in Miami that I used an old towel to wipe off the dew to keep the Long-EZ clean and had to wring out the towel several times. Because the Long-EZ can carry 52 gallons of gas, I never filled the tanks except one time as a test. To lower the nose of my EZ for parking with over forty-five gallons of fuel results in gasoline spewing out the tank vents into the back seat and leaving light blue stripes on the wings after the gas runs off onto the ground. The warmer the weather, the more blue striping.

Fifty-two gallons of unnecessary weight (312 pounds) for local flying is not practical. Some people have opined that condensation happens in metal tanks but not in composite. This is not logical as humidity in cool air condenses regardless of container material. Early morning flyers can verify that dew does form on composite aircraft.

For twelve years, I filled the tanks to about 45 gallons and flew the plane until I needed more fuel. This would average about 25 gallons of air in the tanks during the twelve years, more than the fuel capacity of some aircraft. The only time I found water in the tanks was when the “O” rings needed replacing.

An additional theory to enforce this conclusion, but one I never proved, is the vapor pressure of evaporating gasoline in the tanks probably exceeds the outside air pressure as air cools, so no moist air would enter the tanks through the vents except when flying. Regardless, after twelve years of real world experience, I am convinced the FAA is wrong, again.

There is the question of “P” factor, but this is not the forum for that discussion. (For a book debunking “P” Factor and other old wives tales, download *See How It Flies* by J.S. Denker.)

Pre-Flight - Tires:

Canard flyers know that checking tire pressures, fuel quantity, water in fuel, and oil and hydraulic fluid levels are an integral part of flying, and to a greater extent in Experimental aircraft than when flying commercially built spam cans. “Kick the tires and light the fires” is an invitation to disaster.

Tire pressure needs careful, regular checking. Aircraft tires on light aircraft leak air very quickly. I use 5.00 x 5 tires with 45 pounds of pressure. Air needs to be added about every three weeks. The nose wheel, carrying no aircraft weight when parked, leaks less.

A very knowledgeable mechanic advised me to use 10 ply tires because the Long-EZ uses differential braking for steering. Ten ply tires are stiffer and resist the stress and strain when braking and turning better than six ply tires. Retreads (longer lasting than new tires) are available for around $35 per tire. (See sources in Appendix A, *Resource Guide for Nonbuilder Owners of Canard Composite Aircraft* by Terry Yake.)

The disadvantages of ten ply tires are:

1) Ten ply tires are heavier than six ply tires,
2) 5.00 x 5 ten-ply tires are bigger and create more drag than small tires, and
3) The stiffer, ten ply tires do not give a visual indication of low tire pressure when the plane is empty. When you start to taxi and suddenly realize you need full power to move, you know your tire pressure is low. Check the tire pressure before starting the engine.

The advantages of ten ply tires are:

1) Longer tire life (My first pair of new, ten ply tires needed replacing after five years. I have been using my second set (retreads) for over six years.)
2) Stronger and thicker may mean fewer flat tires and damaged tubes. (I have never had a flat tire since installing ten ply tires over eleven years ago.)

The pilots flying faster ezes use small, lower air resistant 5.00 x 4.0 tires, which are not available in 10 ply versions. David Orr, claiming the title of the “King of Flat Tires,” says that his nose wheel leaks faster than the mains. Out of sight when retracted, the nose wheel still can be lowered a few inches, far enough to check the tire pressure, before leaving the hangar.

Pre-Flight - Fuel Quantity:

The original design of the ezes specified sight gauges (what an oxy-moron!). These are difficult to see from the back seat, and almost impossible for the pilot to see in flight, especially if carrying luggage. You must know the fuel consumption for your aircraft at different power settings. Observe, keep records, and TEST. By knowing your fuel consumption and how much fuel you are carrying, you can plan your flight time accordingly. You enjoy another advantage in a Long-EZ. According to the FAA, a day flight requires carrying the fuel you need, plus thirty minutes of reserve. The Long-EZ lets you calculate the fuel you need, then add another hour or two. You should never join that group of pilots that have run out of fuel within ten miles of the airport. The Long-EZ tanks hold 52 gallons, enough for the O-235 equipped aircraft to fly for ten hours if leaned for economical cruise. Most pilots have bladders smaller than the plan’s gas tanks, so flight time is usually less than ten hours.

David Orr recommends using one tank until only ten gallons remain for the reserve. He then flies off the other tank until empty. He knows he has to land when the engine quits or to switch to the reserve. There is no rush to switch tanks as the plane must slow from cruise speed to 100 mph or less before the propeller stop wind milling. If are not aware by this time, the silent engine is the loudest sound you will ever hear. You will wake up!

Pre-Flight - Portable Step:

As we get older, climbing into the Long-EZ gets harder. One simple solution that draws laughter from the young crowd is to use a large tin can with a string tied to it for retrieval once the pilot is seated. The empty can holds the string without tangling until next time, and the can is easy to place on the floor in the back seat for flight.

If you have a bad back, with or without an old body, your alternative is an electrical nose lift: 1) Bill Oertel, 3216 Broco Lane, Norco CA 91760-1817, phone 909-734-7569), 2) Steve Wright: http://www.canard.com/noselift, or http://bluemountainavionics.com/, and 3) Jack Wilhelmson (http://www.eznoselift.com)

The alternative to getting old is not considered a viable alternative.

Life, without flight, is not worth living.

Richard Bach, *A Gift of Wings*

Taxi:

Extend (open) the air brake to avoid rocks and trash lifted by the front wheel from being thrown back into the wooden prop. Some canard aircraft are equipped with slick nose wheel tires (no tread) to reduce throwing up rocks. (For repair and care of the wooden prop, consult Bruce Tifft's maintenance guide, a part of Appendix A, *Resource Guide for Nonbuilder Owners of Canard Composite Aircraft* by Terry Yake.) When taxiing into position for take-off, have the aircraft moving before applying full throttle (reduce the probability of the propeller picking up rocks).

Avoid idling too long before take-off. While on the ground, engine cooling is very poor as there is no prop blast to force cooling air into the cowling.

Lean the mixture, even during ground operation, to reduce loading the spark plugs. Mixture should be full rich for take-off except when leaning slightly to increase RPM at high elevation airports. One pilot mentions that he always takes off with slight leaning. When doing your run-up, test for maximum RPM with small leaning adjustments. Your mixture control could be slightly out of adjustment.

Avoid overuse of the brakes for steering as heat build up can melt the landing gear strut. Very thin brake pads can lead to a hanging brake, generating even more heat. Crosswind take-offs are especially annoying with the wind-vane effect on the winglets requiring extra braking to taxi the aircraft straight. The brake-heat problem is much less on aircraft without wheel fairings (wheel pants). If you operate from a wide runway, start you take-off from the downwind edge of the runway and turn the aircraft at an angle into the wind to reduce the crosswind component. As speed increases and rudders become effective, braking is not needed.

If taxiing with an open canopy, a common practice during the summer, be aware of wind strength and direction. A sudden gust from the wrong direction can break the original design canopy stop and slam the canopy against the wing with a strong probability of breaking a thin canopy. Replacement is expensive, time consuming, and eliminates flying your plane for a few weeks. A gas spring replacement avoids this problem. (Aircraft Spruce or an RV store offer low cost gas springs. Shop for the best price and get the weakest unit with the very critical open-closed dimension to fit your canopy.)

If your aircraft has the original design canopy stop, when parking on a ramp in hot weather, place a towel or other cloth over the instrument panel to shade your radios and leave a towel or cushion under the canopy for ventilation. But, be sure the safety latch catches before leaving the plane, as a strong gust can lift the canopy and break the canopy stop and possibly the canopy.

Avoid high speed taxiing. Period. A slight bump can cause the nose wheel to lift off the ground, risking a prop strike on the taxiway. This is not the recommended method to reduce the diameter of the prop. You need every inch of prop diameter possible for maximum horsepower and thrust. Another unwanted result of high speed taxiing is brake overheating and strut meltdown from differential brake steering.

Retract the air brake before take-off, unless you are on a gravel strip. Then, retract the air brake after take-off. There is little drag at slow speed so it is not critical to retract the air brake immediately after becoming airborne. The drag increases at higher speed, as you will observe when you try to lower the airbrake during an approach at over 100 knots. Also, when manually closing the air brake at high speed, expect to get a hard rap on the left hand when it closes. Some people advocate electric speed brakes. One disadvantage of the electric speed brakes is they can get stuck open. An open speed brake can interrupt the cooling airflow into the cowling, causing engine over-heating during flight.

Take-Off:

During your run-up, you should set pitch trim for take-off. I use the eyeball method to have about ¾ of an inch space between the trailing edge of the elevator and the trailing

edge of the canard. Every aircraft will be different due to construction, pilot weight, and CG. This method works for me.

The front wheel will lift off the runway about four hundred feet before the mains, so the result of rotating a canard aircraft is not the same as for rotating a standard configuration aircraft. Those ten seconds with the nose in the air and the mains bumping along the runway are an eternity during your first take-off. There is reduced danger of nose wheel shimmy by lifting the nose wheel off the ground as soon as possible. During landing, hold the nose wheel off until full aft trim and full aft stick no longer hold the nose up.

After take-off, be very careful to visually align the canard with or slightly above the horizon, depending on your seat cushion and height. If the canard is too high above the horizon, the canard can stall, much to your surprise after hearing all those stories about canard aircraft not stalling and not spinning. During take-off is not the time to be surprised. Canards and main wings can, and do, stall, though gently. Any aircraft can stall. During your testing, you should determine when your canard stalls and how slowly you can safely fly, but do this testing above 3,000 feet AGL. During take-off is not the recommended time for this test.

If operating from a short runway, know your GO-NO GO speed and distance. Waiting too long to abort on a hot day with a heavy airplane can cause grass, a fence, or worse to collect in your nose wheel and in the cockpit. This can happen at sea level as well as at Big Bear (over 6,000 feet elevation). I use a conservative 60 knots IAS as my GO speed with runway ahead.

Engine Failure after take-off — To turn back or not to turn back

Engine failure after reducing power after take-off does happen. One of my two engine failures in over fifty-six years of flying occurred when I throttled back. Manufacturers of engines say it isn't so, but as long as I can remember, experienced pilots have proclaimed that the high-risk moment for engine failure is when you reduce power after take-off. Pilots can and should operate the engine at full power for as long as needed to get to a safe altitude. Use that power, in spite of an urge to throttle back. Five minutes at full power while climbing at 1,000 feet per minute is more than enough to reach 1,000 feet AGL. Four hundred feet AGL is not a safe altitude for power reduction.

Few pilots prepare for an engine failure on take-off, but every aircraft owner should know the minimum altitude AGL necessary for a safe turn back to the airport in his specific aircraft and with his personal skills. In addition to the altitude loss during the turn, you need additional altitude to glide to the airport and position the aircraft for landing.

It is very tempting to try to return to the airport, and we have lost EZ pilots that way. That long runway behind is much nicer than the houses in front, but it may not be an option. Learn how much altitude you need to do a 30 degree teardrop from the point of power failure in a climb to wings level on downwind and final, and add a hundred feet for surprises.

Turning back is an option only if you are above the minimum altitude determined by practice for your aircraft and your personal flying skills. Observe the surrounding area for

possible emergency landing sites, but realize that almost straight ahead is the only option when the aircraft is below your minimum turn-back altitude.

If an elevator spring breaks during take-off, Rutan designed it to be fail-safe. The plane zooms up (NOT DOWN) and is easily controlled with stick pressure. Obviously, the opposite spring should not break, as there is little tension on it while taking off. Sid recently installed a carbon-fiber elevator spring, a high tech solution for a metal spring subject to breaking.

If taking off with a strong or gusty crosswind, use aileron to hold the up-wind wing low as wind getting beneath the wing can cause the plane to bank very quickly in the wrong direction! The large surface of the winglets aggravate this action. This is another surprise you do not need.

Maintain tight control of the stick during take-off, especially in a high-density altitude condition. Gusty winds can cause the nose to drop back on the runway at high ground speed. The small wheel is not designed for this harsh treatment.

If at a high elevation airport, remember to lean mixture for maximum RPM before take-off.

Climb:

Learn the angle of climb (rate of climb) to obtain good cooling and fast climb for your high power setting. My Lycoming O-235-L2C number four cylinder runs hot unless the angle of climb is lowered. Know your aircraft!

If you have a cylinder head temperature gauge read out but for only one cylinder, attach it to cylinder three or four. My number four runs hottest.

Climb to your cruise altitude as soon as possible, then level and after achieving cruise speed, lean for your maximum fuel economy/RPM/safe cylinder temperatures combination.

Straight and Level:

You have to fly the airplane every second to control yaw. Stick movement rarely exceeds ¾ inch, but the adjustment is continuous during flight. This is a good reason to install an autopilot for long trips. My EZ-Pilot relieves the stress on this 76-year old body and was appreciated during my 34-hour round trip from San Diego to Kitty Hawk for the Centennial in December 2003. You can download a free EZ-Pilot manual at ***www.trioavionics.com*** to understand the ease of use and features of an autopilot that

make flying easier and safer. Pitch in the Long-EZ is very stable and easily controlled with trim.

Mountain flying. Receive flight instruction, study the FAA circular for mountain flying, and learn from local pilots. Mountainous terrain generates strong, unexpected air currents that can surprise you, and that big chunk of granite coming head on is not what we desire in a scenic view.

One safety precaution is to approach ridges at a 45º angle and with at least 1,000 feet of altitude above the ridge elevation. Ridge and lenticular cloud rotors may cause you to need a way out if sudden, unexpected, and strong winds take control of your plane or prevent you from crossing the ridge. If you do encounter an unexpected strong downdraft, follow the technique used by birds – dive and turn away from the danger. Diving gives you speed, and speed is power for controlled flight away from a problem. Usually, you will avoid this risk by arriving at the ridge at least 1,000 feet higher than the terrain.

A bit of advice from an old mountain pilot is, “If you see a mountain goat standing on a cloud, do not fly into that cloud.”

The original canard on the Long-EZ is moisture sensitive. You should test yours. When I bought my Long-EZ, I lived in Florida and had an abundant, daily supply of rain showers for this test. I flew into a rain shower, and the stick pulled out of my hand. I lost 500 feet before I could grab the stick. After drying off the canard, I flew into the shower again, holding the stick firmly. Pitch trim gave me full control of the loss of laminar flow from the rain, and as it dried, the trim was slowly readjusted. My canard is moisture sensitive and easily controlled, not a problem.

Sid says, “Another has to do with flying IMC, especially in visible moisture or in rain. The very rapid change in elevator adjustment, with concomitant application of remarkable trim changes required, cannot be emphasized enough. Power is necessary as well, at times full power with careful leaning to maintain airspeed and altitude control. I have encountered beads of moisture, heavy rain, icing and even hordes of insects, all producing similar effects even to a lesser extent with modified canards, but have never experienced complete loss of control albeit with some loss of altitude.”

While flying straight and level, occasionally, you may notice the stick starts to get heavy. By observing carefully, you will see tiny droplets of water flowing back along the bottom of the canopy. You are in the presence of virga, even on a sunny day. Also, flying into the top of a cloud will cause the same reaction. All of these are entertainment, not problems. High altitude does not change the reaction, as I determined by flying into a small rain shower below a lone cloud over a 13,000 feet bald mountain west of Yellowstone. (Don’t you love the thrill of test flying?)

Enjoy calm flying at high altitude, but be prepared for cold flying. Without heat, the EZ does get cold. Layering gives good protection. My December 2003 trip to Kitty Hawk was the best test I ever made of layering. At every stop, I was sweating after several hours flying with outside air temperature below freezing. The main entry for cold air is the elliptical hole for elevator movement. Plastic newspaper bags over boots help maintain warm feet. Weather stripping seals the canopy well, but a scarf is useful to protect the

face from air entering the temporary open spaces caused by the lifting canopy during flight.

David Orr discovered 12 volt electric socks in a motorcycle store. He gloats over other pilots suffering cold knees and feet.

The comfortable, semi-reclined seat is conducive to napping. The EZ-Pilot autopilot protects me with a feature that circles the last waypoint instead of continuing across the Pacific.

If you fly too slowly, the canard will stall around 60 knots, the nose will drop until speed increases, and then the plane levels off, after a 10-20 feet loss of altitude. You will bob down to the ground unless you add power. This is the safety factor of a canard because the main wing continues flying (normally, no stall) as its stall speed is closer to 53 knots.

Bugs, dirt, and other disturbances to air flow do not cause serious problems on my canard, though some pilots have reported lift loss problems with bugs on the leading edge of the canard and wing. You need to check this and know the result of laminar flow disturbances on your aircraft. During my “Sucker Hole” flight, the entire leading edge of the canard was destroyed by hail. I needed full aft trim, plus positive stick pressure to maintain straight and level flight, but the plane did fly. Note Sid’s comments above.

Stay out of icing conditions. I have never had a problem, and other pilots have encountered ice and lived to tell about it, including Sid Tolchin on his Long-EZ trip to Iceland. The efficient airfoil of the EZ may be critical in icing conditions, so it is better to avoid ice. Fly low where it is warmer, or higher if in an inversion.

Electrical System:

We do not speak openly of our faith and beliefs, but some of us are firm believers that electricity is witchcraft. Flick the switch and gyros turn.

Sid comments, “Another is dependency upon the electrical system. My Vari-eze had no electrical capability when I first flew it, and performance was just fine. But it did show me how electrically dependent I have become in 50 years of flying, carrying me back to my first 7AC Champ. I have had a couple of episodes of loss of electrical supply in several aircraft. These have impressed upon me the need for backup. Yes, the airplane will fly but flight will not have all attributes of safety and comfort. Even in canards, flying is expensive, but there are priorities. No one would consider flying with a known flat tire. The cost of a handheld comm has come down so much that its availability should be a part of preflight. I'm a great believer in pilotage but I feel the same about a backup Nav and the cost of a used GPS handheld is less than the cost of a fuel fill up. I am not about to reduce this to absurdity but I do feel very strongly about these two items.”

Since 1975, new light-weight starters and alternators have been developed. Talk to other Vari-eze pilots for their advice. Old age and hot sun do not make hand-cranking enjoyable.

My latest battery was purchased following the advice of an aircraft, electrical expert, Bob Nuckolls. For seventy dollars, I purchased a recombinant auto battery that fits the space. The improved cold weather performance over the old gel battery is extraordinary.

Bob sells a guide, *The Aeroelectric Connection*, for experimental aircraft electrical systems. (Bob Nuckolls, 6936 Bainbridge Road, Wichita, Kansas 67226-1008 - 316-685-8617, E-mail: nuckolls@aeroelectric.com). Bob makes many references to ezes.

If you are still using a gel battery, remember that you cannot jump a gel battery without damage. Disconnect the battery cables, jump the starter to start the engine, and then reconnect the battery cables. Back in 1989, I bought three batteries after leaving the master switch on and jumping the gel battery. A welding shop owner told me, “Everyone knows you never jump a gel battery!” I did not. But my last gel battery lasted for over five years.

Formation Flying: (http://www.ez.org/Formation1.htm - a PowerPoint Presentation)

See Appendix B, *Formation Flying* (courtesy of Dan Patch, San Diego, CA)

Landing:

Learn to anticipate the airplane. Ezes are slick aircraft, so start your approach 25 minutes out with a gradual descent from cruise altitude. Neither you nor your passenger will feel ear pain when descending at 400 feet per minute. The airlines do this for passenger comfort and to avoid abrupt maneuvers. The commercial airliners are designed to reduce cabin pressure gradually from 7,500 feet to airport elevation. Slow down before entering the pattern, and follow your checklist. Reading a checklist in a high traffic environment is not my favorite pastime, so remember AGUMP (air brake extended, gas from fullest tank, undercarriage down, mixture rich, and fuel pump on in a Long-EZ). Any distraction is a sword hanging over an EZ pilot’s head, especially a distraction that interrupts performing your landing chores, such as lowering your nose wheel.

Some of us admit to making a two-wheel landing, and for a couple of eze pilots, more than one is part of our flying history! David Orr advises, “If this does happen, leave your headset on, get out and keep talking to the tower about your back-up landing system – lower the gear, check it quickly, and taxi away.” This may avoid an FAA Incident Report at a tower-controlled airport.

Other than three trips to the airport to repair the minor damage and the embarrassment of having to face the jeering crowd, this is a non-event. In fact, Rutan advises that if a quick stop is necessary, for example, to avoid hitting a fuel truck, retract the nose gear. The landing rollout is shortened considerably.

Cross the threshold faster than with a Cessna or Piper. I prefer a power off glide of 80 knots on the approach, 70 knots over the threshold, and let the EZ fly itself onto the runway at around 55-60 knots. Use a slight flair, less than with a Cessna or Piper, and the plane will land itself.

During a crosswind landing, maintain the upwind wheel slightly lower than the other wheel until it touches. The EZ is an excellent crosswind landing aircraft, and will stick when the wheels find the ground. If you bounce, you know that you really messed up.

Ed Esteb adds a warning to all new canard pilots flying aircraft with the Rutan original design rudder-brake combination. Applying slight pressure to the rudder pedal activates the rudder. Applying additional pressure to the same pedal activates the brake. Normal landings into the wind are simple. However, a gusty crosswind will require more than usual rudder pressure as you slip and/or crab your way down. DO NOT CONTINUE TO HOLD HEAVY RUDDER PRESSURE AS YOU TOUCH DOWN. Landing with brakes locked can cause the nose wheel to slam down on the runway and possibly damage or collapse the nose gear.

After touchdown, hold the nose wheel off the runway as long as possible. When it does touch, the speed of the aircraft will have slowed down so the elevators and the canard lift no longer provide aerodynamic support. At slow speed, there is little stress on the small nose wheel and nose gear, the weakest parts of the aircraft. You may require a lot of the runway, but the runway is paid for, so use it. Trying to make a quick turn-off to the taxiway may impress anyone watching, but it is a waste of brakes and creates heat that can melt your landing gear strut. The tower controllers like your quick turn-off, but they do not pay for your brakes. Obviously, if you fly in and out of an airport with short runways, plan to replace brakes more often, be aware of the heat problem, and check the brakes soon after touchdown so you can go around if either brake has failed.

If the tower advises a “Go Around” because your nose wheel is still retracted **and your mains are on the ground**, DO NOT APPLY FULL POWER, AND DO NOT APPLY POWER QUICKLY. If you decide to go around, apply about half throttle very slowly. Quick reaction to comply, normal for a pilot, is not good and will cause the two-wheel vehicle to rotate around the axles and push the nose down on the runway. Gradually open the throttle to half power, using the stick to maintain take-off attitude until airborne. Then, apply full throttle for take-off RPM to climb. This method has been carefully tested.

Leave the air brake extended until you turn off the ignition. While taxiing, the air brake may prevent rock damage to the wooden propeller.

If traffic permits, consider the 180º turn from downwind to final for your landing. It is safer with better control than the two ninety degree turns to base and final. At slow speed, my Long-EZ tends to get very mushy in a steep bank and can reach a point where aileron control becomes non-existent. That is not a good feeling, but diving like a bird quickly restores control.

Consider Flying The Safer, Navy 180º Landing Pattern

Instead of flying two right angle turns from downwind to final, make a gentle turn of 180º from downwind to final using 20º-30º of bank. This method:

* Maintains good visibility for high and low wing aircraft,
* Makes it easy to adjust for cross winds by varying bank from 20º to 30º, and
* Maintains stall speed increase to less than 7% of normal straight and level stall speed.

In 1996, three planes crashed at Sun 'N Fun while flying low and slow with steep banks in the landing pattern. Using the 180º turn from downwind to final would have prevented these deaths.

Higher pattern altitudes and pilots over-extending the downwind and base legs are increasing risks for pilots, passengers, and people on the ground. Two reasons are:

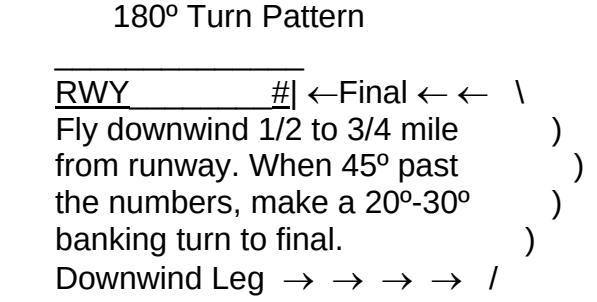
1) Instructors fail to train students to fly close patterns, and
2) New, higher pattern altitudes require earlier power reductions and longer glide paths. (Note this “Navy” method has you cut power when even with the numbers on downwind before initiating the 180º turn. The entire maneuver occurs during a power-off glide.)

Proper training will save lives, especially when flying "low and slow."

The method is simple and easy. Remain within ½ to ¾ mile from the runway on downwind. Do the checklist while on downwind. Cut power, lower landing gear and air brake when even with the numbers. At 45º past the numbers, enter a 20º to 30º bank (wind factor variable) and roll out on final. This eliminates the 90º turn to base followed by another 90º turn to final while flying "low and slow." Touch down 100-200 feet past the numbers.

The British navy developed this method to land Corsairs on carriers during World War II. The Corsair pilot sat far behind the nose, which blocked his view during landing. Eight months later, the American Navy adopted the system.

Bank Angle	Stall Speed Increase	(50) (Knots)
0	0	50
20	3%	52
30	7%	54
45	20%	60
60	40%	70



If aircraft stall speed is 50 knots, a 45º bank is a high-risk maneuver in a slow flying aircraft.

Emergency Landing:

According the Owner's Manual, during an emergency, land with nose gear extended, whether on land or water. The high risk factor during an emergency landing is the landing surface. If the emergency is at night, if you have no knowledge of the terrain surface, if you are over water, swamps, or trees, or if you are unable to determine elevation and terrain surface condition, you may want to use the "falling leaf" emergency landing maneuver taught by the Army Air Corps during World War II. You may destroy the aircraft, but you probably will walk away.

The high-risk variable factor in an emergency landing off the airport is ground speed. Every plane is different, so this maneuver should be practiced when the engine is running and you have a lot of air below, at least 3,000 feet AGL. With a good headwind, your ground speed (and impact force) can be reduced considerably with the "falling leaf." The only aircraft among singles and light twins that I could not do a "falling leaf" was the V-tail Bonanza.

Slow Flying Can Be A Lifesaver.

Kinetic Energy — The Killer in An Emergency Landing!

"If an engine-out landing is unavoidable, check wind direction, choose your landing area, and establish your glide at 70 to 75 knots ... Your landing gear should be down, even for an off-airport landing in rough terrain or water."

"Long-EZ Owner's Manual", p 22

Every homebuilt is a unique and individual flying machine, but an engine out emergency applies to any aircraft. You can determine minimum air speed and descent rate for your aircraft by sharpening your skills and testing your aircraft flight characteristics at a safe altitude. Impact speed and aircraft weight combine to create kinetic energy – the amount determines survival probability. Expect a rough field landing to rip off the landing gear at touchdown, not good news, but it does absorb energy.

It is possible to reduce this impact speed even lower than your aircraft stall speed. My Long-EZ can fly slowly. Practice above 3,000 feet AGL to learn to fly controlled, shallow turns while the plane mushes down with throttle closed, nose high, full aft trim, and full aft stick (both canard and wings are stalled). This "falling leaf" maneuver reduces the speed of the aircraft below stall speed, and you use the rudders to keep the wings level. Practice is necessary, because the plane tends to enter a Dutch Roll. It is very important that the weight and balance be within the CG envelope established by Rutan to avoid a deep stall in this unusual attitude. Rutan tested a canard aircraft and determined a deep stall results from one cause - aft CG.

If you ever get into a deep stall, you have two choices, one is to practice the airline position for a crash. Lean over as far forward as possible with your head between your legs and kiss you're a** goodbye. The second is a possibility of getting out of the deep stall by kicking the plane into a Dutch Roll, easy to do in my Long-EZ. This method has not been tested, but Burt Rutan suggested the possibility to Neil Hunter at Oshkosh after

Neil had experienced a “deep stall” (in a Velocity) and lived. Neil was later killed, but that was an FAA error when they vectored a “heavy” too close to Neil over Orlando Class B air space.

Know the difference between controllers and pilots.

If the pilot makes a mistake, the pilot dies.
If the controller makes a mistake, the pilot dies.

I can overpower the bobbing recovery action of the canard that maintains flying speed when flying straight and level at slow speed. [NOTE: Some canard owners report they cannot overpower this safety factor.] This maneuver requires practice, preferably before an engine-out, off-field landing occurs. N829CL descends at 600 feet per minute in this attitude. The air speed indicator will be inaccurate due to the high angle of attack. I tried to check the true air speed with this exaggerated nose-up attitude with a friend flying a Taylorcraft. Gradually, I pulled away from him as he maintained 50 mph. My forward speed was less than the normal touchdown speed of 65 knots, probably 50-55 knots. The air speed indication was 40 knots, totally inaccurate due to the high angle of attack.

The Long-EZ has a take-off weight limit of 1,425 pounds, and weight is one part of the kinetic energy factor in an off-field, emergency landing. However, weight does not increase the risk as dramatically as does higher impact speed. (See table below.) The lower impact force at 55 knots combined with the strength of the airframe should protect pilot and passenger. Increasing air speed by 13 knots could be a killer.

The 600 feet per minute descent rate is only 10 feet per second, which is a slower descent than that of an Army paratrooper jumping with an open parachute. The 1947, Army 28 feet parachute descended at 12-20 feet per second, with the speed determined by the weight of the paratrooper and equipment. A paratrooper absorbs this shock with his body. The EZ gear should absorb most of the combined forward/vertical impact, even if it is ripped off.

Weight and Speed Create Kinetic Energy

Airspeed at impact is the most dangerous variable!

Kinetic Energy Formula: Kinetic Energy = Weight/2 x Velocity Squared
40% increase in speed almost doubles the kinetic energy.
A 40% increase in weight increases the kinetic energy by 40%.

Weight (Lbs.)	Velocity (Mph)	(Kts)	Kinetic Energy	Multiple (same weight)	Multiple (same speed)
1,000	50	43	1,250,000		Adding 20 mph.
1,000	55	47	1,512,500		almost doubles
1,000	60	52	1,800,000		kinetic energy
1,000	65	55	2,112,500		at any weight.
1,000	70	60	2,450,000	1.96	1.0
1,200	50	43	1,500,000		

1,200	70	60	2,940,000	1.96	1.2
1,300	50	43	1,625,000		
1,300	70	60	3,185,000	1.96	1.3
1,400	50	43	1,750,000		
1,400	70	60	3,430,000	1.96	1.4

Maximum speed shown above is 60 knots. Many canard pilots land faster – more killing power!

Compare: 1,000 lbs at 43 knots and 1,400 lbs at 60 knots.

Kinetic Energy: 1,250,000 3,430,000 = 2.744

With weight and speed within limits, higher speed increases kinetic energy by almost three times!

Conditional Inspection:

Sid says “My personal belief is that the owner/flyer should become very involved in the annual inspection, even though the inspection is required to be accomplished by an A&P. Gene Scott taught me that knowing the workings cannot but assist in understanding how to fly the airplane, no matter the level of mechanical sophistication (of the pilot).”

After fifteen years flying the EZ, starting with a minimum of mechanical knowledge and no composite experience, I agree wholeheartedly.

The last four pages of Terry Yake’s *Resource Guide for Non-Builder Owners of Canard Composite Aircraft* are the annual *Conditional Inspection Check List* for maintaining, checking, and preparing a Long-EZ for sign off by an A&P. You can learn to do much of this work under supervision. An AI inspection is not required for Experimental aircraft.

The airplane talks to you. Listen.

This axiom has been proven. Rarely does a mechanical problem occur without warning.

All canard aircraft owners can benefit from Terry Yake’s *Resource Guide for Non-Builder Owners of Canard Composite Aircraft*. The 76-pages of information about maintenance and sources of products is Appendix A. Also, Appendix C, *Resources….*, includes Terry’s many Internet linked sources of information and products. We are grateful to Terry for making this collection of information available for all pilots.

Any aircraft will last a lifetime, if you are careless enough.

One of the beautiful things about single piloted aircraft is the quality of the social experience.

Richard Bach's Observations Of Pilots

Bach states, "I suspect the thing that makes us fly, whatever it is, is the same thing that draws the sailor out to sea. Some people will never understand why, and we can't explain it to them."

"It is a cautious, conservative figure, and true - ninety percent of the people who own light airplanes today can't afford to own them."

"Rationally speaking, most pilots can't afford to own the airplanes that they do. They give up a second car, a new house, gold, bowling, and three years lunch to keep that Cessna 140 or a used Piper Comanche waiting for them in the hangar. They want these airplanes, and they want them desperately."

"Most pilots are absolutely uncaring about the kind of automobile they drive, the precise form of house they live in, or the shape and color of the world around them."

". . . that special high place where a few hundred thousand people around the world have found answers to emptiness."

"The facts are very simple. The man who flies is responsible for his own destiny . . . Flight remains the world of the individual, where he decides to accept responsibility for his action, or he stays on the ground."

"This act of flight is the path that each has chosen, that each needs to demonstrate his control of space and time in his own life."

Flyers:

"… are distressed when they must blindly trust uncaring others to take them where they want to go.

… feel a certain kinship with the earth unencrusted by humanity, they want to see it that way in one sweeping view, in reassurance that nature still exists on her own, without a chain-link fence to hold her.

… value the fact that one cannot give excuses to the sky, that in the air it is not talking that matters, but knowing and acting.

… have a sense of adventures yet to come, instead of dimly recalling adventures of long ago as the only moments in which they truly lived."

"Aspire to this kind of flight...dare to be different, independent, self-reliant, alone."

Book review editor,
WASHINGTON POST

“The joy of flight. The magic of flight. The meaning of flight. The endless challenge and infinite rewards of flight. For all who wish to rise above their earth-bound existence to feast on the freedom and adventure that Richard Bach knows and loves and recreates so magnificently, this book offers *A Gift of Wings*."

Editor's introduction to *A Gift of Wings*

Appendix A, *Resource Guide for Non-Builder Owners of Canard Composite Aircraft* by Terry Yake

Appendix B, *Formation Flying,* by Dan Patch, also available in a Power Point Presentation at **http://www.ez.org/Formation1.htm.**

Appendix C, *Resources….* by Terry Yake, containing many web links.