Federal Aviation Administration

Sport Aviation Safety

FAA Safety Team

These are the note pages to go with the Sport Aviation Safety power point presentation. The numbers below coincide with the slide numbers.

1. This presentation will take up to a 2 hour block of time to present with a break in the middle. The FPM may need to hide slides if less time is given to present this program. The main focus items for the participants to take from this program are the importance of transition training (Up or Down) as well as the proper planning and execution of first flights. Remember that a first flight is also relevant to a new owner of an aircraft.

2. The 4 bullets on this slide are meant to be used to introduce the safety records for Amateur Built aircraft and this program.

BACKGROUND:
The experimental airplane community is an important part of the civil aviation industry in the United States. Amateur aircraft builders have produced some of aviation's greatest technological achievements. The amateur builder community is foundational to general aviation in the US. However, recent trends in experimental airplane accidents have suggested a need for increased effort in ensuring that pilots of experimental airplanes are prepared for the challenges of these airplanes. Historically, experimental airplane flight operations represent a small component of flight hours, but a significant percentage of General Aviation (GA) accidents. For example, 2009 accident data showed that while experimental airplanes are involved in approximately 27% of fatal accidents in the United States, they fly only 3.4% of the total general aviation fleet hours. This represents a nearly 8 to 1 ratio of fatal accidents per flight hour over the mainstream general aviation community. Unfortunately, most of these accidents happen to second or third owners. The main cause of experimental airplane fatal accidents is pilot performance particular in the transition phase to an unfamiliar airplane. While some increase in risk in experimental airplane flight operations might be acceptable to the general aviation

community and the general public, in order for the recreational, educational and experimental benefits of amateur built airplanes to flourish, both FAA and industry agree that improvements in safety are needed. Although there is FAA guidance in the form of FAA Advisory Circulars and Handbooks available for transition training a more proactive approach is needed. Through collaboration between FAA and the general aviation and amateur built community, the recommendations contained in this outreach program should mitigate some of the risks found in experimental airplane operations.

CURRENT REGULATORY AND SYSTEM SAFETY SYSTEM ENVIRONMENT FOR AMATEUR BUILT AIRCRAFT

Manufactured small airplanes (that is Cessna, Cirrus, Piper, etc.) are built under the stringent regulations of 14 CFR part 23. As such, there are specific requirements for stall speeds, handling characteristics, stall characteristics, and reliability, among other requirements. A “Standard” airworthiness certificate is normally issued. Amateur built airplanes are not required to meet these standards and are issued an “Experimental” airworthiness certificate. Although Experimental airworthiness certificates come with conditions and limitations attached these are usually operational in nature. So, although amateur built airplanes might handle vastly different from standard airplanes, there is no requirement for additional training. NOTE Light Sport airplanes are also not certificated under Part 23. But they are all required to meet the ASTM standard, which would include standards for stall speeds, handling characteristics, stall characteristics etc.

3. The chart shows a continuing increase in Fatal Accidents.

4. This chart show the various Light Sport Aircraft. Note the increase in Experimental Light Sport Aircraft as the “Fat Ultralights” transitioned into the ELSA fleet

5. While the LSA Fatal Accident Rate is lower than the Amateur Built Fatal Accident Rates the rates are still higher for this relatively new form of aviation than is desired.

6. Loss of Control is sited as one of the primary accident causal factors. All the items listed on this slide can be used to prevent Loss of Control.

Skill based training begins with identifying desired skills, assessing the pilot for that specific skill, determining the gaps and accordingly structuring the training program.
Training in general is important to maintain proficiency. Transition training up or down can help prevent loss of control.
Proficiency by exercising your skill to stay sharp.
Managing your risk, The strategies to manage risk include transferring the risk to another party, avoiding the risk, reducing the negative effect of the risk, and accepting some or all of the consequences of a particular risk. There is always some degree of risk. We accept this risk when operating an aircraft in the air. But we want to manage that risk.
Mitigating your chances of Loss of control by applying all of the items on this slide

Physical Limitations. Read and understand the physical limitations of your aircraft. These are designed and developed to keep you safe. Operation within these limitations is imperative to keep you and your passengers safe.

7. Have multiple fuel level indicators, and consider carrying a bubble level to level up your aircraft to take calibrated fuel measurements on the ground.

Be aware of crosswinds; they can cause problems and can have gusts that exceed aircraft or pilot limits.

8. Use a suitable runway. Make sure it is long enough, wide enough, free from ruts and pot holes, and not to soft or to wet. Powered parachutes may well require a flying field, not a runway or strip.

Always have a no-go point for every takeoff and abort the flight if you are not airborne.
Consider the height of the grass prior to takeoff or landing.
Are you as the pilot prepared for any actions that may be needed.

9. No comments

10. Sport aviation comes in a variety of types and sizes. This program is meant to familiarize you with the aspects of certification and operation for Experimental Amateur built and Experimental Light Sport aircraft (ESLA) and Special Light Sport aircraft (SLSA). The surge of these aircraft has taken off with the development of lighter weight composites, fabrics, designs, engines and the implementation of recent FAA Rule changes. Thank you for attending this program. Our hope is to make you aware of this new aspect of aviation and the cautions of not getting proper transition and instruction prior to operating as well as maintenance and construction considerations.

11. This slide talks about the various Sport Options.

1. Experimental Amateur Built What is an amateur-built aircraft?
Title 14, Code of Federal Regulations (14 CFR), part 21, section 21.191(g), defines an amateur-built aircraft as an aircraft “the major portion of which has been fabricated and assembled by person(s) who undertook the construction project solely for their own education or recreation.”

2. Other Experimental Aircraft Other could include Research and Development, Crew Training, Exhibition, Air Racing

3. (1) Such as some Aeronca, Luscomb, J-3, Taylorcraft, type aircraft
(2) Must meet a consensus standard for Special Light Sport aircraft published by the American Society for Testing and Materials (ASTM). SLSA manufactures are still governed by design standards.
(3a) Has been assembled- From an aircraft kit for which the applicant can provide the information required by §21.193 (e); and
In accordance with manufacturer's assembly instructions that meet an applicable consensus standard.

(3b) This option is no longer available. This was an option while the Fat Ultralights transitioned to the Experimental Light Sport category but this option is now closed.

12. Experimental Amateur-Built aircraft that meet the definition of light sport can be operated by a Sport Pilot or a Pilot flying under the limitations of Sport Pilot. But they must meet the definition below.

Light-sport aircraft means an aircraft, other than a helicopter or powered-lift that, since its original certification, has continued to meet the following:
(1) A maximum takeoff weight of not more than—
(i) 1,320 pounds (600 kilograms) for aircraft not intended for operation on water; or
(ii) 1,430 pounds (650 kilograms) for an aircraft intended for operation on water.
(2) A maximum airspeed in level flight with maximum continuous power (VH) of not more than 120 knots CAS under standard atmospheric conditions at sea level.
(3) A maximum never-exceed speed (VNE) of not more than 120 knots CAS for a glider.
(4) A maximum stalling speed or minimum steady flight speed without the use of lift-enhancing devices (VS1) of not more than 45 knots CAS at the aircraft's maximum certificated takeoff weight and most critical center of gravity.
(5) A maximum seating capacity of no more than two persons, including the pilot.
(6) A single, reciprocating engine, if powered.
(7) A fixed or ground-adjustable propeller if a powered aircraft other than a powered glider.
(8) A fixed or autofeathering propeller system if a powered glider.
(9) A fixed-pitch, semi-rigid, teetering, two-blade rotor system, if a gyroplane.
(10) A nonpressurized cabin, if equipped with a cabin.
(11) Fixed landing gear, except for an aircraft intended for operation on water or a glider.
(12) Fixed or retractable landing gear, or a hull, for an aircraft intended for operation on water.
(13) Fixed or retractable landing gear for a glider.

13. There are six other classes of experimental. Some of them might meet the definition of Light Sport Aircraft.

14. These are examples of other category and class of Light-sport aircraft.
Airplane single engine land.
Examples are standard category J-3 cub,
a two-place ultralight trainer that will now be a certificated and registered Light-Sport aircraft if registered on or before 1-31-08,
and an example of a new "ready-to-fly" light-sport aircraft.

A "light-sport aircraft" means an aircraft, other than a helicopter or powered-lift, that since its original certification, has continued to meet the following:
A max takeoff weight of 1320 lbs; or 1,430 lbs for water operations.

A max airspeed in level flight with Maximum continuous power (Vh) of not more than 120 kts calibrated airspeed.
A max (Vne) speed of 120 knots. for gliders. A max stall speed without lift-enhancing devices of 45 KTS.
A Maximum Seating Capacity of two persons (including pilot).
Single, reciprocating engine (if powered).
Fixed-pitch or ground-adjustable propeller if a powered aircraft other than a powered glider.
A fixed-pitch or feathering propeller if a powered glider.
A fixed-pitch, semi-rigid, teetering, two-blade, rotor system, if a gyroplane.
A non-pressurized cabin, if equipped with a cabin.
Fixed landing gear , except for an aircraft intended for operation on water or a glider.
Fixed or retractable landing gear , or a hull if an aircraft intended for operation on water.
Fixed or retractable landing gear , if a glider.

15. Focus on no requirement for a specific airworthiness certificate established in definition—similar to "large" aircraft and "small" aircraft definitions.

Significant comments on definition…
Many comments on weight --- less (900+) and more (1700) Considered comments, particularly those justifications for a small increase.
Increase or removal of maximum Vh-115 knots
Fixed landing gear and prop --- The need to maintain the simplicity of operation, maintenance and manufacturing drove how FAA considered those comments

16. Lighter than Air, Glider, and gyroplanes

Gyroplanes are a category of LSA. They may hold an experimental, light-sport, amateur-built, or exhibition certificate.
They may not be certificated special light-sport aircraft (SLSA)– "ready-to-fly".

17. Weight-shift control and powered parachutes are new categories of aircraft that are now defined in regulations. Part 1.1
    These classes did not exist prior to the light sport rule.
18. Powered and Unpowered Para-gliders and Tandem Hang glider. All tandem Para-glider training needs to be foot launched.

What is not a LSA? Hanglider, paraglider, (powered and unpowered) helicopter, multiengine….

19. The black numbers are the total number aircraft certified in the particular category/purpose.

The red numbers are fatal accidents since 2005. (Light Sport has been in existence since 2005)
The blue numbers are the percent of the total number of aircraft certified in the particular category/purpose that have had a fatal accident. GA has two percentages.

One is if Exp and LSA are included in the number, and one is if they are not. It doesn't make much difference.

The interesting thing about statistics is that you can prove most anything with them. We generally hear about our great accident rate. The normal way to express our accident rate is accidents per take off, or per hours flown. It is an astoundingly low number. What happens if we look at accidents by number of aircraft registered in any particular category/purpose? There are 230,000 Type certificated GA aircraft that had 2176 fatal accidents since 2005. 8801 LSA aircraft with 66 fatal accidents and 33,000 Amateur-Built aircraft with 393 fatal accidents since 2005. The percentage of fatal accident per aircraft is nearly the same for each category.

20. These are the basic Sport Pilot Privileges and Limitations.   Read through slide.

21. The Carol and Brian Carpenter quote is from the book, “Sport Pilot Airplane, A Complete Guide” It was written when most light sport aircraft were transitioned low speed/high drag ultra light trainers. However we have noticed an issue with certificated pilots flying aircraft that fit the definition of light sport.

This is a matrix of pilot type in the vertical axis and aircraft type in the horizontal axis.
Point out the lower right quadrant. 66 Light Sport fatalities since 2005.
There are two spikes worth pointing out. S-LSA operated by rated pilots and Amateur Built/Spot Pilot eligible operated by rated pilots with expired medicals operating with a driver’s license.
A possible explanation of these accidents is lack of transition training. S-LSA look like type certificated aircraft, but they are different, and there is a need to obtain transition training.
The issue seems to be that 152 “Heavy” pilots are flying lighter slower lower performance

22. A pilot would not consider transitioning from a Cessna 152 to a Boeing 787 without a tad bit of training. The idea woks both ways. A Boeing 787 pilot would have a tough time landing a Cessna 152 without some transition training. So it is with a Cessna 152 “heavy” pilot trying to operate a Quicksilver. The aircraft fly quite differently. Certainly a Quicksilver pilot also needs to train prior to operating a Remos or CT.

It is essential pilots receive transition training to transition up or down the performance range of aircraft.

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23. This is a balloon/powered parachute midair collision. Fortunately no one was killed, but two people were seriously injured. Formation flight is something to be coordinated prior to takeoff. CFR Part 91.111 (a) No person may operate an aircraft so close to another aircraft as to create a collision hazard. (b) No person may operate an aircraft in formation flight except by arrangement with the pilot in command of each aircraft in the formation. The rulle that applies to the parachute is CFR Part 103.13 Operation near aircraft; right-of-way rules. (a) Each person operating an ultralight vehicle shall maintain vigilance so as to see and avoid aircraft and shall yield the right-of-way to all aircraft. No person may operate an ultralight vehicle in a manner that creates a collision hazard with respect to any aircraft. Powered ultralights shall yield the right-of-way to unpowered ultralights. There are good reasons for such rules. This is a great example. Part 91 may not apply to vehicles, but it is full of common sense recommendations.

From the NTSB Report
A Lindstrand 90A hot air balloon, sustained substantial damage following a midair collision with an unregistered ultralight. The balloon pilot and one passenger sustained minor injuries; one passenger sustained serious injuries. The pilot of the ultralight sustained serious injuries. Visual meteorological conditions prevailed and no flight plan was filed. Both the balloon and the ultralight had departed from the same Airport.

According to the balloon pilot, he was at 5,500 feet mean sea level when he saw the ultralight pilot maneuvering close to the balloon envelope. He called to the ultralight pilot to maneuver the ultralight away from the balloon, when the ultralight impacted the envelope of the balloon. As the balloon and the ultralight descended, they remained connected and the balloon pilot tried to slow the rate of descent. Following the accident, the ultralight pilot told the balloon pilot that he was taking photographs when the collision occurred.

24. **Ultra-light, balloon collide**
Investigators from the Federal Aviation Administration will look into a midair collision between a hot air balloon and an ultralight aircraft known as a paraplane, according to police.
The FAA will review evidence of the crash, which occurred about 8 a.m. Saturday. The balloon and the paraplane were taking part in Airfest 2010, a celebration of aviation.
A festival attendee said he watched the entire incident unfold several hundred feet in the air. The paraplane appeared to be circling the hot air balloon when the collision took place. The paraplane became entangled with ropes attached to the balloon and both aircraft began spiraling down to the ground. It took the balloon and parpalane about 45 seconds to descend, “They fell slowly at first, then accelerated as hot air escaped from the balloon,”.
The pilot of the paraplane was strapped into the aircraft as it fell. Three others clung to the inside of the balloon’s wicker basket as it descended.

Before the two aircraft hit the ground, a tall chain link fence broke their fall.
The three occupants of the balloon were transported to with unspecified injuries. The pilot of the paraplane did not appear to have life-threatening injuries.
At this point, it is uncertain as to the cause of the accident. It is possible the cause could be related to mechanical failures, inattention or both.

25. The cost to the pilot was incredible. He was charged 1000 dollars per branch the forest service cut. The Coast Guard sent an HH-60 Jay Hawk to lift him out of the tree. The mission failed, but he was charged for three hours of Jay Hawk and crew.

26. Emergency Locator Transmitters are not required in many cases. For instance, single pilot aircraft, some ferry flights, some test flights, agricultural application flights. However if you happen to be hanging in a tree, hoping the rangers eventually find you. You may consider a 406 ELT as they are more advanced or a good handheld radio to be very handy.

27. The pilot of this ultralight Phantom was demonstrating low altitude acrobatics to his friends at a fly-in. The outboard section of his left wing failed in overload. The aircraft was so active in its decent that it interfered with the emergency chute. Unfortunately the accident was fatal for the pilot.

28. Emphasize that the aircraft no mater what type of flying machine will perform differently when you start adding passengers. Be aware of the performance change for weight, balance, weather conditions. <u>Their will be a decrease in performance!</u>

29. These are pictures of a fatal "Ultra-Light" crash. The first thing to notice is that the tail is right side up and the aircraft is upside down.

The tail was overloaded, that caused the tail boom to fail from bending strain.
When tubes fail from bending they deform, causing a dent in the area subjected to compression strain. As the failure continues, the area subjected to tension strain fails. The dented area is then subjected to tension strain, and fails pulling a tendon out of the dented area.
The question at this point is, "What caused the overload?"

30. The entire aircraft was designed to weigh less than 254lbs. The instrument panel installed in this ultra-light was fully capable of instrument flying. It must have required a power system too. The panel and support including a battery more than likely weighed a high percentage of the 254lb total weight of the vehicle.

31. The ingredients for a Carburetor Ice issue are the proper temperature and humidity, a venturi that reduces the pressure of the air and cools it, atomized fuel that further cools the air and a throttle butterfly valve or slide. Viola! Carb ice.

Does your aircraft have carburetor heat?

Perhaps some engines are less susceptible than others. Oil mixed with fuel reduces the effect. Heat risers and fuel systems utilizing injectors also help. All aircraft are susceptible to impact air icing.
Does your aircraft have an alternate air source?

32. Physics got this guy. Notice the sky in the lower right picture. I'm sure he was experiencing severe clear when his engine quite for no apparent reason.

When the investigators arrived they had the owner start the engine. It ran great! The aircraft had fuel. The fuel filters were clear. The ignition was fine and the engine was not broken. The failure happened in cruise flight so it was possibly carburetor ice.

33. These are the sections of the flight manual required by consensus standards for Special Light Sport aircraft. We are used to such information because similar information is included in flight manuals for type certificated aircraft. Amateur built aircraft do not have this information. It is up to the builder to develop the information during the time flown in the flight test area. Certainly to think through emergency procedures would be handy, but performance and normal procedures are vitally important. If the data is not developed it can set up sharp, careful, pilots to have accidents. Such is the next accident.

34. This is an RV-6 that crashed. The pilot was not real familiar with the airport. The airport is tricky for a couple of reasons. One is that it has quite a dip in the center of the runway. The other reason is that it is about a mile from the ocean. The runway is parallel to the shore, so there is a nearly constant onshore breeze which means it is also a nearly constant cross wind. The trees you see in the picture line the edge of the runway, so the wind at the runway surface is gusty as it burbles past the trees.

The pilot was a disgusted guy. We know that, because he told the investigating inspector so. He's the guy sitting on the fireman's tool box with the disgusted look. He said he flared to land and because the aircraft floated a bit he was caught in the burble from the trees. He thought he was going to blow off the edge of the runway so he applied power to go around. The P factor then brought the nose around until he was headed into the trees. You can see the result.

So let's analyze this accident. What do we know about most amateur builders? Do they spend the 40 hours assigned them in their test area actually test flying their aircraft? Some do, but many just, "ensure that the aircraft has been adequately tested and determined to be safe to fly within the aircraft's flight envelope." In other words boring holes in the sky. There is another reason to test fly your aircraft it is to use flight test data, "to develop an accurate and complete aircraft manual and to establish emergency procedures."

So how might this have helped the gentleman in the slide? Did he develop the data he needed to know the "over the fence" airspeed or did he add 5 knots to his approach because he was at an unfamiliar airport? Did he perhaps add a little more airspeed for his wife and family? After all he certainly didn't want to be a stall spin statistic. Most of this is speculation but it points out how not having a good flight manual might lead a very skilled careful pilot to fly into a situation where his skill or the capabilities of his aircraft are overwhelmed.

Let's look at an amateur-built flight manual that is less than helpful.

35. This is a flight manual from another RV-6 accident.
Build 1
Notice there is no registration number on the cover.
Build 2
Well, there was plenty of other information blank in the book. The engine listed is not the engine installed.
Build 3
N/A
Build 4
This was a second owner aircraft. The seller didn't include the airworthiness certificate in the deal. Do you suppose he included the construction manual? More missing performance information.
Build 5
The stains? They are blood. Fortunately it was not a fatal crash, but very painful all the same.
It is essential operators of aircraft are familiar with the flight manual of the aircraft they are flying and the manual needs to have not only emergency procedures but normal ones too. Approach airspeed, Fuel burn, stuff like that.

36. Here are pictures of an accident. Let study this accident to look at the factors involved. There were two occupants of the aircraft. Both were seriously injured. The cause is currently unknown.

37. The Qualt 200 is an experimental light sport aircraft. Notice how lightly it is constructed. Notice the foam ribs. The aluminum tubing is seat structure. See where it carried away? See the bulkhead carried away from the tail cone? Light Sport aircraft are lightly made because they are designed; well, to be very light.

38. Flying light sport aircraft is somewhat like riding motorcycles in that there is less protection designed into the vehicle. The operators of such aircraft accept more risk. The best plan to stay safe on a motorcycle is to not have an accident. The best plan to stay safe in a light sport aircraft is to avoid accidents by paying attention to maintenance, by carefully planning each flight, and by conducting a diligent preflight inspection of the aircraft. This aircraft was ripped apart by the chain link fence it encountered, not that a Type Certificated aircraft wouldn't do the same thing under some circumstances. There is just a bit more beef in the structure. The point is that personal protective equipment might be a consideration such as a helmet. Perhaps shoes that won't slip off. Warm clothing in the winter, and the list goes on. Yes, in hindsight, these guys probably wish they had been

wearing helmets. They both had a rather harsh encounter with the instrument panel.

39. The way this airworthiness certificate is mounted shows a misunderstanding of the certificate.

Build 1

Here is a close-up of the certificate. Notice in section E it is stated that “Operating limitations dated ….. are a part of this certificate. The operating limitations are missing.

Build 2

Usually special airworthiness certificates are displayed like this. The pink card is stapled to an 81/2 by 11 sheet of paper that describes the operating limitations of the aircraft. This is where an aircraft might be restricted to day VFR, or a flight test area may be defined. Where an experimental may be prohibited from operating for compensation or hire. Where the pilot may be required to have a certificate or letter of authorization to fly the aircraft.

It is essential aircraft operators read and comply with the operating limitations of any aircraft they operate.

40. No Information

41. Emphasize that the A&P mechanic still needs to meet the requirements of part 65.

42. Keep in mind when working on Special Light Sport Aircraft you still have the requirement to do the work in accordance with the instructions developed by the manufacture of the SLSA.

43. Information on slide.

44. Just like any aircraft, sport aircraft have manufactures manuals to train and guided the mechanic and owner thought maintenance tasks.

45. Keeping the engine running is huge!

AC 20-105b Reciprocating Engine Power Loss Accident Prevention and Trend Monitoring states that 51% of power loss accidents were caused by pilot actions or inactions. Know your fuel burn and range. You must confidently know your fuel situation at all times. Have multiple fuel level indicators, and consider carrying a bubble level to level up your aircraft to take calibrated fuel measurements on the ground. Verify fuel quantity before each flight. Do not guess! Do not take off unless you have enough fuel for the flight. Manage fuel while flying. Use a watch, have a fuel time limit for every flight. Sump your tanks before every flight.

Don’t tinker with your prop. Particularly with two cycle engines. The higher the RPM the leaner the mixture, the lower the RPM the richer the mixture, so adjusting the prop changes the fuel air mixture of the engine. When the prop is set out of the range provided by the manufacturer the carburetor will need to be adjusted. Jets changed, idle mixture and float level adjusted. When the engine is adjusted outside the limits provided by the manufacturer the engine will be much less reliable, and much more likely to be damaged.

Dispose of fuel that has reached its shelf life. For instance, If the aircraft has been in storage for the winter, drain the fuel and service it with fresh fuel. Fuel is so inexpensive compared with the cost and pain of injury.

46. These are the seals between carburetor and intake manifold. When the manifold pressure is low a leak at the boot can cause the engine to quit. Manifold pressure is lowest when the throttle is retarded. So a leak may well cause the engine to quit on approach to landing. It is an inconvenient time. Checking for cracked or poorly fitting boots may well be a good preflight item.

47. First the term "cold seizure" is a bit of a misnomer. All seizures are caused by heat/friction. A cold seizure is where the piston expands faster than the bore it is traveling in and contacts the sides of that bore. These are also known as four corner seizures.

    The worst case scenario is that the engine can just lose power and stop. In the case of a mild (mini) seizure the engine may just lose power for a second or two, but will respond to throttle inputs and will recover when the throttle is advanced. This may happen a few times before a major seizure occurs.
    Cold seizures "usually" occur after a full throttle run when the engine is powered back to a cruise throttle setting. If the engine has experienced some previous mini seizures, the stoppage can occur anytime in flight as there is already some aluminum (off the piston) attached to the cylinder wall and galling (unwanted removal of aluminum from the piston to the cylinder wall) will be occurring at a variable rate.

    In a cold seizure scenario the engine may just sputter and lose rpm for a second or two, or it may bring the engine to a complete stop. Once the engine has cooled down a bit it will appear to re-start and run properly.

Don't let this fool you. More than one person has tried to fly his plane out of a field where they had to land because the engine quit, only to have the engine fail again in short order. Unfortunately, the second failure usually happens when the pilot has fewer options for a safe off field landing.

48. The red arrow is pointing at the muffler where a support is missing. The question is where did it go? The prop blade gives us a clue.

<u>Build 1</u>

If you look closely you can see threads from the bracket bolt in the gigantic ding on the prop. So can a composite prop sustain this type damage? How it it to be repaired. A call to the manufacturer reveled that the nick was within tolerance, and there was no repair for the nick.

49. Top left, See the chunk knocked out of the piston?
Bottom right, Here is a cracked ring land.
Bottom left the top of the piston is scrubbed of carbon as if it had been bead blasted in an abrasive cleaner.
These are indications of detonation.

Detonation (also called "spark knock") is an erratic form of combustion that can cause engine damage. Detonation occurs when excessive heat and pressure in the combustion chamber cause the air/fuel mixture to auto-ignite. This produces multiple flame fronts within the combustion chamber instead of a single flame kernel. When these multiple flames collide, they do so with explosive force that produces a sudden rise in cylinder pressure accompanied by a sharp metallic pinging or knocking noise. The hammer-like shock waves created by detonation subject the piston, rings, spark plug and rod bearings to severe overloading.

<u>Ten causes of detonation</u>
1. Low octane fuel. Stale or contaminated fuel. Jet A.

2. Misadjusted or “tweaked” turbo charger. Keep compression within reasonable limits. For supercharged or turbocharged applications, a static compression ratio of 8:1 or less may be required depending on the amount of boost pressure.

3. Misadjusted ignition timing. Timing too advanced.

4. Wrong spark plug heat range can cause detonation as well as pre-ignition.

5. Engine overheating. A hot engine is more likely to suffer spark knock than one which runs at normal temperature.

6. Malfunctioning of the heated air intake system.

7. Lean fuel mixture. Rich fuel mixtures resist detonation while lean ones do not. Improperly adjusted propeller, air leaks in intake manifold gaskets, carburetor gaskets or the induction plumbing downstream of the throttle valve can all admit extra air into the engine and lean out the fuel mixture.

8. Carbon deposits. An accumulation of carbon deposits in the combustion chamber and on the top of the pistons can increase compression to the point where detonation becomes a problem. In addition to increasing compression carbon deposits also have an insulating effect that slows the normal transfer of heat away from the combustion chamber into the head. A thick layer of deposits can therefore raise combustion temperatures and contribute to "preignition" as well as detonation.

9. For those with turbochargers, check the boost pressure. Adjust it to the factory recommended settings. Controlling the amount of boost in a turbocharged engine is critical to prevent detonation.

10. Prevent lugging of the engine by restoring prop settings to the factory specifications. Resist the urge to “tinker”.

50. The red arrow is pointing at the pin that holds the wing on a trike. It is a time life part. It is good for 100 hours or one year. Of course the one in the picture is timed out. The point is that LSA aircraft have parts that need to be replaced regularly. The maintenance manual will have the information.

51. Those who are in a position to pick design features of their aircraft (Amateur Builders) need to pick well. Most pilots learn to fly type certificated aircraft we are used to a central drain for the fuel system that we can drain on each preflight inspection. There is no such requirement for amateur built aircraft. The accident in the top right picture was caused at least partially by the builder installing glass inline fuel filters. The glass inline fuel filters were installed in such a way that they could not be cleaned without draining the fuel tanks. They were never cleaned, and they got very packed with debris. The engine quit and the pilot was left without good options for landing. The aircraft impacted the truck in the picture. The pilot survived, so it proves RV-6’s are “Built Ford Tough”.

14 CFR § 23 does not apply to amateur built aircraft, but it offers good advice for design features like fuel drains. 14 CFR § 23 is not the only source of such information. There are many books written on good design features. The point is just to pick well when picking design features. The extra expense will pay off in the end.

§ 23.999 Fuel system drains.

(a) There must be at least one drain to allow safe drainage of the entire fuel system with the airplane in its normal ground attitude.

(b) Each drain required by paragraph (a) of this section and §23.971 must—

(1) Discharge clear of all parts of the airplane;

(2) Have a drain valve—

(i) That has manual or automatic means for positive locking in the closed position;

(ii) That is readily accessible;

(iii) That can be easily opened and closed;

(iv) That allows the fuel to be caught for examination;

(v) That can be observed for proper closing; and

(vi) That is either located or protected to prevent fuel spillage in the event of a landing with landing gear retracted.

52. This is a beautiful RV-8. It has an automotive rotary engine installed. The engine relied on an electronic computer to time the ignition and fuel injectors. The automotive fuel injectors also required a minimum pressure from the electric fuel pumps. The engine was very dependent on the electrical system to run. There were no magnetos installed so there was no magneto switch with which to secure the aircraft. The builder chose to install a master switch operated by a key to prevent unauthorized persons from starting the engine. The switch he chose was an automotive switch that was swaged together as opposed to an aircraft quality switch that screws together. In flight, the switch vibrated apart causing a loss of

the electrical system. The engine quit, leaving the pilot with few options for landing. He was forced down in a vineyard that ripped his beautiful airplane apart. He and his wife escaped with their lives, but with broken bones. Certainly in hindsight he would have happily spent the money for a high quality switch.

53. Far 43 does not apply to ultralight vehicles, or Amateur-Built Aircraft, so AC 43.13-1B doesn't apply either. However, if there are questions as to how to use aircraft hardware AC43.13-1B is a good place to look for the answers to those questions. For instance, Chapter 7, Section 4, paragraph 7-64 states "After the nut has been tightened, make sure the bolt or stud has at least one thread showing past the nut."

54. You are looking at a bag of lead shot wedged between the rudder pedals and the tubing structure of the aircraft. It is not secured. This is not a good way to add ballast.

55. These are examples of problems that could be remedied by good workmanship. The fuel line wouldn't be chaffing if it fit and was tied properly. Too much RTV on exhaust system springs can actually make them fail. The maintenance manual will show the proper way to maintain these components.

56. The rusty thing in the picture is the pin that holds the wing on. It was damaged when the operator didn't remove the control push rod before knocking it out. The control rod was also damaged. Both parts were weld repaired. The wing pin is rusty because the heating of the pin during welding removed the cadmium plating. Rusty, pitted parts tend to fail in fatigue, and they tend to damage the hole they are designed to fill. The control rod could have been repaired in a more appropriate way. It is simply butt welded, and the reinforcing weld material is ground away.

This aircraft is certified experimental light sport, so there are no workmanship standards that apply to it. The operator is within his rights to repair his aircraft in this way. However there is guidance for repair such as this. Generally it is in the maintenance manual. If it is not in the maintenance manual then the FAA's AC 43.13-1B has guidance for repairs such as these weld repairs. The AC 43.13 is posted on the web and available for free.

57. This is the aftermath of a fatal amateur built crash. The aircraft was constructed mainly from 3mm luan plywood (Door Skin). The wing failed when the aircraft made the base to final turn.

An engineer who offers engineering consultation to amateur builders including structural analysis happened to see the crash. He was quoted in the local newspaper as saying, "I inspected the wing and I could not believe what I saw. The wing was hardly glued together with only 25% of the joints bonded." In this picture you can see the skin of the wing. There are three glue bond indications. 1. Voids where no glue was applied. 2. Whetted areas where glue was applied but failed because it was mixed improperly or not clamped. 3. White areas where the glue stuck and the wood failed. (This is the only area where the glue joint performed properly.) So 25% might be a generous estimate of glue bond effectiveness.

58. This is an experiment by the builder. Some amateur-built kits have been evaluated by FAA and others have not. Evaluations are not required by regulation, nor is a manufacturer required to have a kit evaluated before selling it. Buyer beware, make sure you do your homework.

Remember that prior to issuing an airworthiness certificate for an Experimental Amateur Built Aircraft the FAA must find that the aircraft complies with acceptable aeronautical standards and practices and the aircraft is in condition for safe operation. After completions of all the applicable paperwork the FAA than issues an Experimental airworthiness certificate and Operating Limitations.

59. Applicant must be advised that after airworthiness certification has been issued, thy must show compliance to 91.319(b) by developing a flight test program addressing requirements, goals, and objectives of each test flight. Advisory circular AC 90-89 can be used to help develop this Aircraft Flight Manual.

60. <u>Recommended Flight Training</u>

Know your airplane's systems, limits and recommended procedures before you begin flying. Consult the kit vendor for advice. Discuss your situation with type club members and owner/builders of your airplane model. Internet forums and chat rooms may provide valuable information, but remember the participants may or may not have the technical expertise you seek, and their airplanes may exhibit different stability characteristics than yours.

A thorough airplane check-out by a qualified instructor with experience in your airplane model is always a good idea. If you built the airplane yourself, consider obtaining this training from the kit vendor, preferably in your airplane, but the company demonstrator may provide sufficiently similar characteristics. If you purchased your plane from a previous owner, learn all you can from him or her. Pilots transitioning to experimental airplanes must be aware that the habits and reflexes learned on type certificated airplanes may yield hazardous results.

61. Know your airplane's systems, limits and recommended procedures before you begin flying. Consult the kit vendor for advice. Discuss your situation with type club members and owner/builders of your airplane model. Internet forums and chat rooms may provide valuable information, but remember the participants may or may not have the technical expertise you seek, and their airplanes may exhibit different stall behavior than yours.

62. A pilot would not consider transitioning from a Cessna 152 to a Glasair SII (220 MPH aircraft, Stalls 73 MPH) without a tad bit of training. The idea works both ways. A Glasair pilot would have a tough time landing a Quicksilver without some transition training. The aircraft fly quite differently.

It is essential pilots receive transition training to transition up or down the performance range of aircraft.

63. Transitioning pilots should be encouraged to participate in the EAA Flight Advisor Program. Additional information is available by going to the EAA's web site at www.eaa.org. A link is available to find a Flight Advisor.

Only a small number of pilot/builders take advantage of the EAA's Flight Advisor program, around 25% of Experimental Armature Built owners contact a EAA Flight Advisor for assistance.

64. The EAA Technical Counselor program is used by over 80% of the Experimental Amateur Built owners building their own aircraft. So why is this program more popular that the Flight Advisor program. It is thought that while most pilots are already pilots and believe they can operate an aircraft safety. Many Experimental Amateur Built builders are building a first aircraft or may not be that familiar with aircraft construction techniques so emphasis is placed on research, construction techniques, materials, design. We need to comparatively spend more time in preparation for first flight and flight testing to decrease the accident rate.

65. Experimental Amateur Built aircraft are not constructed to any standard. While the construction techniques and materials can be of superior quality, things can be missed. In the case of this aircraft the air filter was sucked into the intake system causing a power loss and subsequent off airport landing.

66. Quality of construction is superior. Things can still be missed.

67. In this case you had to take a Bracket Air Filter and cut it to fit the air box design. A specific filter is not available for this aircraft because this is an Experimental Amateur Built aircraft The owner had taken a Bracket filter with is a two part foam type filter and cut it to shape. Also in doing so the outer edges of the filter that are glued together were cut off. This also increased the likelihood that the filter could be sucked into the intake system.

A filter retaining screen was added to prevent further occurrences of the air filters ingestion into the engine intake system. So, even the best of construction can miss something that could lead to problems.

68. This slide explains how to access sport aviation online resources.
Open faasafety.gov
Click on the resources tab.
On the drop down menu, select online resources.
When the online resources page opens, select resources by type of operation.
When the type of operation page opens select the resources by operation of interest. Such as Amateur-Built.
Click on Amateur-Built then find the needed resource, like AC43.13-1B.
Click on the AC43.13-1B link and the title page opens. This page allows the operator to check the revision date.

Click on the required PDF link and the data appears.

69. The Light Sport Aviation Branch of the FAA (AFS-610) is available to support your questions. The 610 branch is located at Oklahoma City, OK and can be contacted at the above information.

70. Remind the participants that further information is available through www.FAASafety.gov

71. Last slide end of program.