Flight Advisor Note #1
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Will Fox

Hi Fellow EAAers,

Amateur built aircraft are great. They give you the opportunity to get a lot of aircraft for the money and often times they have better performance in certain areas when compared to the typical certified aircraft. On top of this, you can maintain them yourself if you get your repairman license. So what is the down side? Well, for one, because they are not certificated aircraft, they may not be designed, manufactured, or even maintained to FAA standards and this can have an impact on safety.

The Problem

I wanted you to know about some alarming trends in experimental aircraft safety, that have developed recently. Do you know that the fatality rate for amateur built aircraft has increased by 40% in the last four years? Do you also know that the overall fatality rate in amateur built aircraft is almost three times greater than that for personal use GA aircraft. What is going on here? That is the question that the EAA and the FAA are asking. See the attached article from the EAA that discusses amateur built aircraft safety. These accidents are not only killing pilots but also passengers and people on the ground.

A Velocity aircraft crashed and killed the pilot and two people in their home.

These trends cannot continue unabated or the non-flying public will demand a greater federal involvement in regulating the activities of builders of amateur built aircraft. I fear that if we EAAers can't turn this trend around, the feds will certainly get involved to "help" us with the problem. I think we all know how that generally works; more restrictions on amateur

built aircraft construction and use. So, given the accident trends, what might we deduce from them and what can we do to change things? It appears that more than 50 % of the fatal accidents result from some sort of loss of control by the pilot. The manufacturers of higher performance aircraft kits such as Vans and Lancair are seeing a higher percentage of fatal accidents than the general amateur built aircraft population. Lets take a look at these higher performance aircraft and try to see what might be the causing the increased accident rate.

The Data

Below is a breakdown of the three primary probable causes of fatal accidents in Vans RV aircraft based on my search and interpretation of the NTSB aircraft accident database:

31% are related to Stall/Spin accidents.
18 % are related to Maneuvering at low altitude.
13% are related to Loss of Control for unknown reasons.

Vans RV flips over while taxing.

Below is a similar breakdown of the three primary probable causes of fatal accidents in Lancairs:

27% are related to Stall/Spin accidents.
27 % are related to Maneuvering at low altitude.
23 % are related to Loss of Control for unknown reasons.


Fatal Lancair 360 crash.

The Causes

What could be causing these types accidents? Here are some ideas that have come up in my discussions with other EAA members and local pilots.

1) Pilots are building aircraft with considerably more performance than they have experience with.

The maximum cruise speeds of the RV series are in the 160knots -180 knots range. In the case of the Lancair aircraft, we are talking cruise speeds greater than 200 knots. It is easy to get behind in a plane moving this fast if your flight experience revolves around flying lower performance aircraft like a C-172 or perhaps a PA-28. I still remember my first experience flying a Mooney M20F with cruise speeds of 140 knots. I found myself in a 140 knot airplane with a 105 knot brain. Things were happening very fast on my first approach in the Mooney, so I involuntarily started pushing on the toe brakes on final to try to slow the plane down. Luckily, I realized what I was doing before I touched down, otherwise there would have been a lot of smoke and excitement on landing. I ended up landing long, but fortunately for me it was a long runway. Higher performance aircraft are noticeably slipperier and tend to be more difficult to slow down and go down at the same time. It is not uncommon at all for pilots unfamiliar with high performance aircraft to initially overshoot their aiming point for landing or to miss the runway entirely because they are unaccustomed to how fast things can happen

2) Pilots are focusing on building their aircraft to the extent that they allow their piloting skills to erode.

It takes a lot of determination and focus to build an amateur built aircraft. As you begin to see the light at the end of the tunnel, finishing the aircraft becomes almost an obsession. All your time, energy and money seem to be going toward one goal and that is to get the plane ready to fly. If you have a choice of spending money on renting an aircraft to fly to keep your flying skills in good shape, or instead, buying a neat radio or getting that cool paint job for your homebuilt, I can tell you from experience there really is no choice. You

say to yourself, “why rent an airplane when pretty soon I can be flying my own”. So the degradation of flying skills is a very predictable result of building an airplane unless you work hard to maintain those skills. Some builders give up flying all together while they are building and then plan to get a quick checkout when the time comes to fly their own bird. This can be a problem if the checkout is in a Skyhawk and their amateur built is a Lancair Legacy or RV-6.

3) Many high performance amateur built aircraft designs are much less forgiving of human error than certificated aircraft.

Many high performance amateur built aircraft have higher wing loadings than your average Cessna, Piper, or Mooney. The RV Series wing loading range from 14.8 – 18.6 lbs/ft^2. The Lancairs range from 21.4 – 36.2 lbs/ft^2. For comparison a C-172 is 14.1 lbs/ft^2, a PA-28 is 13.4 lbs/ft^2 and a Mooney M20C is 15.4 lbs/ft^2. High wing loadings make the aircraft’s approach and stall speeds higher, their glide speeds and power off descent speeds higher, and reduce their maneuverability. The RV-series and Lancairs also tend to have light controls and that makes them easy to over control. Their stall characteristics can be abrupt with little or no warning and it is not uncommon to find that the aircraft stalls asymmetrically, that is one wing stalls before the other, producing a pronounced yaw and roll following the stall.

I had a chance to experience first hand, the less than desirable stall characteristics that some amateur built aircraft designs have when I stalled a Lancair IV for the first time. The factory pilot had warned me that the Lancair IV typically stalls asymmetrically and to make sure that I had the gear down to prevent the aircraft from over speeding during the recovery. The power off stall was pretty exciting with an abrupt departure and a roll to a nearly inverted attitude, but what was most alarming was the loss of almost 1800’ before recovery from the stall. This is not an aircraft you want to get anywhere near the stall speed in the pattern.

My experience with RVs is that their stalls are symmetric in a well-built plane, but occur with little or no aerodynamic warning. In other words, the aircraft does not warn you that it is about to stall. It keeps flying until the wing reaches the critical angle of attack and then it stops flying. This behavior can result in an unpleasant surprise for the unwary pilot, who is maneuvering at low altitude and not paying attention to his airspeed and coordination.

Remember those wedges mounted to the leading edges of Mooneys and Bonanzas, They help to give the pilot some aerodynamic feedback prior to the stall and also to tame the stall characteristics. How often do you see these types of devices on an RV or a Lancair? I haven’t seen one yet. The percentage of fatalities associated with stall/spin accidents is a clear indication that improvements in this area of high performance amateur built aircraft design are needed.

Many of the stall/spin accidents are preceded by an engine failure. Aircraft with high wing loadings have high glide speeds and high descent rates. If a pilot is unfamiliar with these characteristics, it is natural to increase the angle of attack and try to slow the aircraft speed and descent rate down, particularly if

they are maneuvering close to the ground for an emergency landing. It is easy for a pilot to become a stall/spin accident statistic in this scenario when you combine it with a lack of sufficient stall warning and an abrupt or asymmetric stall. Pilots of these types of aircraft should strongly consider installing a stall warning device in the plane. They should also conduct routine training involving stalls and stall recovery, recovery from spin entries, and emergency procedures.

More Data

I would also like you to think about some other data. Let's ask the question "How new is the aircraft and how familiar is the pilot with the aircraft when the fatal accident occurs? This might give us an indication of whether the accidents occur as a result of shaking out the aircraft during the first forty hours of testing or later on when the pilot has more experience with the aircraft and begins to expand the operating envelope. I took a look at the NTSB Accident Database and below is a table showing the percentage of fatal accidents for Vans RVs and Lancairs for a given number of flight hours on the aircraft.

Total hours on aircraft	1-40	41-100	101-500	501-1000	1000+
% fatal in:					
RV	5%	10%	50%	35%	0%
Lancair	9%	25%	50%	9%	9%

The majority of the accidents occur between 101 and 500 hours. This is a bit surprising. One might think that the majority would occur in the first 40 hours while the aircraft and pilot are both being tested. However, the majority of the accidents occur, not during initial testing, but rather later after the pilot should be pretty experienced with the aircraft and the bugs should have been worked out. So what is going on here? Here are a few possibilities to consider:

More Causes

1) As pilots become familiar with their amateur built aircraft and comfortable with their ability to fly them, they accept more risk when flying the aircraft.

There is a very interesting book called the "Killing Zone: How and Why Pilots Die by Paul Craig". It discusses accident rates for pilots and concludes that the highest probability of being in a fatal accident for a new pilot is between 50 and 350 hours (The Killing Zone). Craig attributes the high fatality rate to a variety of human factors and discusses how to survive the Killing Zone. It should be required reading for all new pilots. It appears that the human factors Craig discusses may also be applicable to pilots of amateur built aircraft, but instead of pilot flying experience as a whole, we are talking about pilot experience with a particular homebuilt. Why might this be the case? Pilots of

amateur built aircraft tend to be very careful during the initial forty-hour testing stage of their aircraft and many do not really explore the performance envelope of their aircraft during this test period. I had one pilot tell me during his test period, that he was tired of flying around in 20 mile circles and wanted to start using the plane for cross country flying. I asked him how his stall testing had gone, and he said that he hadn't done any stalls and didn't plan to do any because he didn't plan to stall the aircraft flying cross-country. I also think that the Flight Advisor program, that is focused on initial testing and flying of amateur built aircraft, works well for those that take advantage of it and helps to reduce accidents during the initial test phase. What might be happening though, is that as pilots get more experience with their amateur built aircraft they become more confident and complacent, and as a result accept more risk.

The result of a midair collision between two experimental aircraft.

2) As pilots become more comfortable with their aircraft, their inspection and maintenance of the aircraft decreases.

Many pilots choose to maintain their own amateur built aircraft. This makes sense, since they are most familiar with the aircraft. However, it is not a trivial effort to maintain your own aircraft in good flying condition. The maintenance standards the FAA requires of certificated aircraft should be considered a minimum requirement for safety. Most amateur built aircraft will need more attention to maintenance than a certificated aircraft. It can be hard to maintain an objective eye towards maintenance. For example, a pilot-owner-mechanic might say to himself, "That canopy latch doesn't always latch correctly and I probably should fix It while I'm doing the annual condition inspection, but I promised to take the wife on a trip so I better skip it for now and do it later this year". It is easy to believe that pilots may be more interested in flying and less interested in maintaining their amateur built aircraft if they have a choice. This is even more believable if there is little or no perceived consequence or risk by

doing so. I could give you numerous examples of complacency when it comes to amateur built aircraft maintenance, but let me focus on just one.

A few months ago, a pilot visiting our airport in his amateur built aircraft, aborted his takeoff several times due to a misfire in his engine. He parked the aircraft on the ramp and as I pulled up to give him a hand, I noticed that fuel was pouring out of the engine. It turned out that the carburetor was full of contamination and the float needle was sticking. After a bit of discussion I found out that the pilot-owner-mechanic had been flying the aircraft for several hundred hours, but had not complied with any of the service bulletins issued by the engine manufacturer, and in fact, did not even own a service manual for the engine. He had been having trouble with the engine for a few months, but told me that the problem cleared up once he was in the air and flying for a while. To say that this attitude towards flying and maintaining an amateur built aircraft is caviler is an understatement! This pilot was very experienced, but had virtually no experience maintaining the type of experimental engine he had on his aircraft. I helped him disassemble and clean his carburetor, and elicited a promise from him to address the service bulletins and do a better job of maintenance in the future. He departed with the engine running well and I hope he kept his promise for his own sake and that of his passengers.

If the pilot/ mechanic of high performance amateur built aircraft survives 500 hours, the data suggests there is a pretty good chance that their flight and maintenance experience has matured to the point that their probability of surviving is much greater. If they survive for 1000+ hours the picture improves still further.

Solutions

Think about the data and causes that I have presented, I'm sure that you can come up with some other, perhaps better causes. Lets discuss them and see what solutions we can develop to improve the situation. Let me propose some solutions that we can use to get the discussion started:

1) Discuss and get the word out on the negative performance characteristics as well as the positive ones, associated with various amateur built aircraft designs, so that builder-pilots can make an objective choice about the type of aircraft that is right for them.

2) Offer fellow builders a ride in your airplane to help them develop and maintain their flying skills while they are building their aircraft. If you fly an amateur built aircraft offer a ride to someone who might be interested in building one like yours and show them both the positive and negative flying attributes.

3) Encourage pilots to develop skill levels commensurate with the aircraft that they are building. This is one aspect of the EAA Flight Advisor program. Furthermore encourage builder-pilots to get a thorough checkout in the type of aircraft they are building with a

qualified CFI. Also, encourage pilots to spend some time with their flight advisor or a CFI after they get some flying experience in their amateur built aircraft to discuss how to expand their flight envelope to include emergency procedures, unusual attitudes, instrument flying, aerobatics, etc.

4) Develop a good inspection checklist for the annual condition inspection of your homebuilt. Stick to it. Consider doing hundred hour inspections if you fly more than a hundred hours a year in the aircraft. Get a knowledgeable and objective person to look at your aircraft during the annual condition inspection and give you some feedback. Your Technical Counselor or local A&P is a great resource for this, so take advantage of him or her.

5) Observe the behavior of your fellow pilots, if you think they are taking unnecessary risks let them know about it, or if you are uncomfortable with that, let a Flight Advisor or FAA Safety Councilor know. The life you save may be theirs, their passenger, or your neighbor in the house down the street.

Glasair III in flight.

I think we EAAers are fully capable of turning these trends in amateur

built aircraft safety around. If we have the dedication and discipline to build an aircraft, we certainly should be able to fly it and maintain it safely. There is no reason that amateur built aircraft can't be as safe or safer than certified aircraft. All it takes is a commitment on the part of each builder-pilot to make it so. I'd like to hear back on your thoughts on this subject.

Thanks

Will
Chapter 691
Technical Counselor and Flight Advisor