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Vol.5 No.3 | March 2016

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Vol.5 No.3 | March 2016

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FEATURES

DEPARTMENTS

ON THE COVER: Ted Goble flies his unique Bradley Special during EAA AirVenture Oshkosh 2015. Photo by Darin LaCrone

SPARK PLUGS AND THE ROTAX ENGINE

Part 2

BY CAROL AND BRIAN CARPENTER

IN PART 1 OF THIS article, we discussed the theoretical aspects of the spark plugs installed in the Rotax engines. In this article, we will take a more in-depth look at the practical aspects and the how-to of the spark plug in the Rotax engine.

SPARK PLUG REMOVAL

When removing the spark plugs during an annual inspection, or at any time for that matter, keep in mind that there is a lot of information to be had by "reading the spark plugs." A spark plug rack is a useful way to keep track of the cylinder position of the spark plugs as you remove them. The spark plug rack should be labeled with both the cylinder number as well as top or bottom position. (Figure 1) If you don't have a spark plug rack, you can simply make one from a cardboard box by cutting a couple of holes in an X pattern and labeling them with a marker. Place the spark plugs with the electrode end facing up so that you can read them. In Part 3 of "Spark Plugs and the Rotax Engine" we will take an in-depth look at troubleshooting the Rotax engine by reading the spark plugs.

Figure 1: Spark Plug Rack

Keeping track of the spark plug location is not just for identifying potential problems within a particular cylinder, but for more practical reasons as well: We want plugs located within a single cylinder to have nearly identical wear pattern so that the redundant ignition systems will have a similar spark profile. If one spark plug is worn significantly more than the other plug within that cylinder, the ignition system with the worn spark plug will have to work harder than the cylinder with the new spark plug. This will produce an uneven ignition event within the cylinder. If the plugs are to be reinstalled into the engine, they should always be placed back into the same cylinder from which they were removed, and should be kept as a set. Replacement of one spark plug should warrant the replacement of both spark plugs within that cylinder.

"Drop it once, drop it twice," the second time should be in the garbage can. Never use a spark plug that has been dropped. The potential for micro cracks occurring within the insulator after being dropped is significant enough that it's not worth the risk. The cracks may not initially be causing a problem, but after several hours of operating time, the heating and cooling cycles may cause the cracks to propagate to the point of causing a plug failure. If you're removing the spark

ILLUSTRATION BY CAROL AND BRIAN CARPENTER

plugs on a Rotax 9 series engine for the purpose of doing a compression check, remember the engine is going to be hot. Always wear gloves. The most common reason for dropping a plug is that it's—well—hot!

SPARK PLUG REPLACEMENT

For the Rotax 9 series engines, Rotax recommends inspection, gapping, and cleaning at 100 hours and replacement at 200 hours. With the exception that replacement is recommended at 100 hours if you use 100LL more than 30 percent of the time. For the Rotax two-stroke engines, the Rotax spark plug application chart lists the NGK BR8ES spark plug. (Figure 2) Rotax also recommends the NGK B8ES spark plug that does not contain the internal RFI suppression resistor. If your aircraft contains any kind of avionics or a radio system, you would probably not want to use the nonresistor type of spark plug. However, it is important to recognize that the resistor-type spark plugs do reduce the voltage to the spark plug electrodes, and typically, you will find that you will have an improved spark with the use of a nonresistor plug. We have seen anecdotal evidence of improved starting performance on two-stroke engines in very cold weather and with engines mounted inverted when using nonresistor type spark plugs. The two-stroke engines require replacement of plugs every 25 hours.

SPARK PLUG CLEANING

You may be familiar with the spark plug cleaning routine normally associated with spark plugs used in Continental and Lycoming type engines. It is not uncommon that we can use a set of spark plugs, in these types of engines, for 1,000 hours of operating time. It's also not uncommon that we will need to clean these spark plugs on a fairly regular basis. Every 50 to 100 hours of operating time would be a normal interval to be inspecting and cleaning spark plugs on a typical general aviation training aircraft. The spark plugs used in these types of aircraft can cost anywhere from $30 to more than $100 each. With these costs, spark plug cleaning becomes a necessary routine.

However, when we're talking about the automotive type spark plugs, which we use in a Rotax engine, it is not considered normal practice to clean them, especially with an abrasive blaster. The cost of the NGK spark plugs is in the neighborhood of $2.50 to $3.50 each. Even the cost of labor to properly clean and test these spark plugs makes it an impractical exercise. There is some anecdotal evidence that suggests the use of abrasive blasting media to clean these types of spark plugs increases the surface roughness on the ceramic and lessens the spark plugs' ability to burn off the carbon buildup on the insulator.

The Rotax manual is very clear on the subject, "*Attention: Never clean spark plugs with an abrasive cleaner*." We do know that the use of media blasting does help to round off the edges on the electrodes. It is the sharp edges

Rotax Spark Plug Application Chart							
Engine	Rotax 447 Engines	Rotax 503 Engines	Rotax 582 Engines	Rotax 912 80 HP	Rotax 912S 100 HP	Rotax 912iS Fuel Injected	Rotax 914 Turbo
Plug MFG.	NGK	NGK	NGK	NGK	NGK	NGK	DENSO
P/N	BR8ES*	BR8ES*	BR8ES*	DCPR7E	DCPR8E	DCPR8E	X27EPR-U9
New Gap	0.5mm 0.02 in.	0.4mm-0.5mm 0.016-0.02 in.	0.5mm 0.02in.	0.6mm-0.7mm 0.023-.027in.	0.6mm-0.7mm 0.023-.027in.	0.6mm-0.7mm 0.023-.027in.	0.6mm-0.7mm 0.023-.027in.
Tightening Torque	27Nm 238in.lb.	27Nm 238in.lb.	27Nm 238in.lb.	20Nm 177 in.lb.	20Nm 177 in.lb.	20Nm 177 in.lb.	20Nm 177 in.lb.
Plug Change Interval	25 HRS**	25 HRS**	25 HRS**	100*** / 200	100*** / 200	100*** / 200	100*** / 200
Thread Application	Dry	Dry	Dry	Heat Paste	Heat Paste	Heat Paste	Heat Paste

* Use of B8ES is approved on engines not sensitive to RFI from the ignition system (No Radio Aircraft)
** Inspect spark plugs at 12.5 hrs for new engine and then replace at 25hr intervals
*** Inspect every 100 Hrs, Replace every 200 Hrs, Replace every 100 Hrs if using 30% or more leaded fuel
Note! Always consult the current parts and service manuals for the most up to date information

Figure 2: Rotax Spark Plug Application Chart

of the electrode that promote a good clean spark. Cleaning, if at all, should be relegated to the task of spraying with carb cleaner and then blowing them out with an air nozzle. If you have a spark plug condition in need of more than this, you would probably benefit from new spark plugs.

All of the debate about cleaning automotive type spark plugs in the Rotax engine is really kind of irrelevant. A properly set up, maintained, and operated Rotax engine should never see any problem with spark plug performance in between the required spark plug inspection or change interval. Only engines that have some significant deficiency require extraordinary spark plug maintenance.

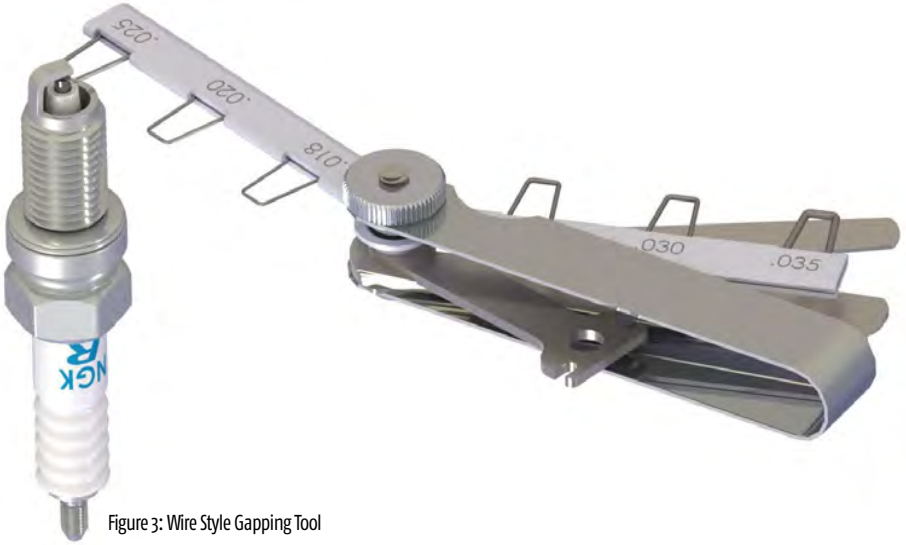

Figure 3: Wire Style Gapping Tool

GAPPING THE SPARK PLUG

It is important to note that the part number on the spark plug is used for a multitude of different engine applications. As a result, the plugs will, typically, not be correctly gapped for your particular application. It is absolutely essential that you check and, if necessary, adjust the spark plug gap. When adjusting the gap on a spark plug, NGK recommends that the maximum adjustment be no more than 0.008 inch from the out-of-the-box setting. Adjusting more than 0.008 inch will stress the ground electrode or cause a misalignment between the electrodes. Either of these conditions could contribute to poor spark performance.

The recommended procedure for checking the spark plug gap is to use a wire type feeler gauge. (Figure 3) This type of feeler gauge is a bit more accurate when

ILLUSTRATION BY CAROL AND BRIAN CARPENTER

the center and ground electrodes are not parallel. Adjusting the spark plug gap is accomplished by moving (bending) the ground electrode using a plug gapping tool. Spark plug gapping tools can be obtained at most automotive parts stores. The recommended gapping tool is similar to the one shown in Figure 4. The slots built into the gapping tool should be placed over the ground electrode and very carefully pried up or down to reposition the ground electrode. Make certain that you do not make contact with the center electrode or ceramic insulator. Prying against the center electrode could result in cracking of the insulator. In cold weather, the Rotax manual indicates that gapping to the minimum dimension can assist in engine starting. You might think that you would want to do this on all of your spark plugs, all of the time, but keep in mind the smaller the gap, the easier it is for the spark plug to become fouled and stop functioning. In contrast, by gapping the spark plug larger, to avoid spark plug fouling, you can, in turn, make it difficult for the engine to start as well as increase the potential for misfire during normal operations.

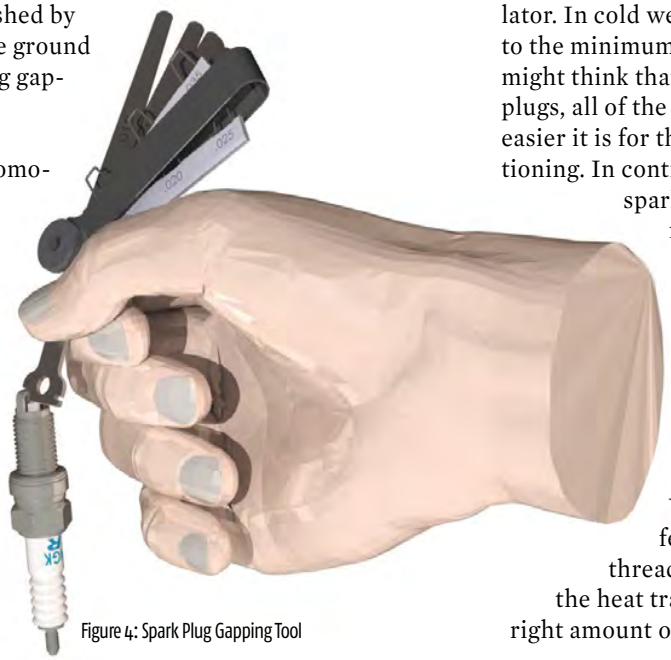

Figure 4: Spark Plug Gapping Tool

HEAT TRANSFER PASTE

All of the Rotax 9 series engines call for the use of heat transfer paste on the threads. Last month, in Part 1 of this article, we talked about the reason behind the use of heat transfer paste. This is a case where "a little dab'll do ya." We would like to ensure that we have heat transfer paste 360 degrees around the perimeter of the threads. Using your finger, try to remove as much of the heat transfer paste as possible. This will leave just the right amount of paste within the threads of the spark plug body.

Figure 5: Heat Transfer Paste

(Figure 5) We also like to make sure that we keep the heat transfer paste away from the firing end of the spark plug as it can foul the spark plug if it gets onto the electrodes. Normally, we do not apply any heat transfer paste to the last three threads of the end of the spark plug.

SPARK PLUG GASKET

We will always be using the gasket that comes with the spark plug when installing the plug on a Rotax engine. Even if we're using a CHT probe, for example on a Rotax 503, the spark plug and gasket will be installed through the CHT probe heat sink that will be resting directly against the cylinder head. Remember, we are measuring cylinder head temperature not spark plug temperature. This is different than we would typically see on a Continental/Lycoming type installation where the spark plug gasket is removed and a 1/8-inch thick copper heat sink thermocouple probe would be installed in its place. When installing a new spark plug, during the torquing process, the gasket will squish considerably before the plug comes up to the proper torque. If the plug is removed and reinstalled, it will only take approximately 1/12 of a turn after it is seated to once again come up to the proper torque. Keep in mind, if you're troubleshooting a problem on the engine, constant removal and installation of the same spark plug can result in the sealing gasket on the base of the plug to be flattened to the point that it no longer is providing an effective seal.

SPARK PLUG INSTALLATION

The Rotax maintenance manuals are very clear about installing the spark plugs on a cold engine only. Check the condition of the threads before installation of the spark plug. Ensure the spark plug has been gapped according to the Rotax specifications. Install heat transfer paste on Rotax 9 series engines. Then, when installing the spark plug, screw it in by hand until it is seated against the cylinder head. Next, torque to the proper torque specifications listed in the Rotax manual for your engine. Use a properly calibrated torque wrench. And ensure that the spark plug socket is properly aligned with the spark plug so as not to damage the insulator.

ILLUSTRATION BY CAROL AND BRIAN CARPENTER

SOLID TERMINAL VERSUS THREADED TERMINAL

This is one of those areas where, it seems, everyone has to learn the hard way. When purchasing a set of spark plugs for your aircraft, you can have the right part number and still end up with the wrong spark plug. There are solid terminal type, and there are threaded terminal type. The part number is the same, but it is the stock number that is different. Ensure, when you order, that you are in fact ordering the type that you need. The Rotax 9 series engines use the threaded terminal type that comes with a screw-on top that can be used with other engines with different types of spark plug caps. This screw-on cap should be removed for the Rotax 912 engines. (Figure 6) If you accidentally ordered the solid terminal type for the Rotax 9 series engine, they are unusable and will not fit the 9 series caps. With the two-stroke engines, either the screw-on cap or the solid terminal type will work. However, there are many disadvantages to the screw-on aluminum cap. Suffice it to say, it is standard practice to order the solid terminal type for all of the two-stroke engines. Many engines have failed as a result of the screw-on cap failing.

We have provided a broad overview of some of the differences in the application and procedures when it comes to spark plugs in the Rotax engine. The underlying theme with the Rotax engine is always the same. The information contained within the Rotax manuals remains your ultimate source for successful use and operation. Rotax has put a lot of effort into giving you guidance and reference material for successful operation of your engine. If you find yourself straying away from the procedures recommended by Rotax, you are probably on the wrong track. And the information from Rotax regarding the use of spark plugs is certainly no exception. The good news is, the spark plugs used in the Rotax engines are very seldom the cause of any problems; moreover, they most often bear the telltale signs and symptoms of other problems brewing inside your engine. In Part 3 of this article, we will look at these telltale signs and discuss how to read the spark plugs. *EAA*

Carol and Brian Carpenter, EAA 678959 and 299858, owners of Rainbow Aviation Services, have co-authored two aviation books and team teach the Light Sport Repairman Workshops. Brian is a CFII, DAR, A&P/IA, and the designer of the EMG-6 (an electric motor glider). Carol is an SPI, PP, LSRM, and FAAST representative.

Figure 6: Threaded Terminal Spark Plug

Fly-in arrivals park on the edge of a sod runway.

FOOD, FAMILY, FLYING

Secrets of chapter success

BY DAN GRUNLOH

AS THE YEAR 2016 rolls in, simple arithmetic reveals that I have spent one-half (34 years) of my entire life as a member of EAA Chapter UL30. I don't remember what it was like to not be a member of a local EAA chapter. I did that for only a few months in 1981. I was lucky an ultralight chapter was formed in Champaign, Illinois, at just the time I was becoming interested in ultralights. Now a third of a century later it is hard to imagine what my aviation life would have been without the friendship and camaraderie of chapter members.

EAA estimates that about 45,000 of its 190,000 members are participating at the chapter level. The other 75 percent of the members don't get the benefit of a chapter connection for support, fun, or expert advice. Of the approximately 900 EAA chapters around the world about 24 of them are identified as ultralight type chapters. Most are small chapters that have been going along successfully for three or more decades. They are no different than any standard EAA chapters except for the ultralight designation.

Chapter UL30 rarely has more than 30 members and goes by the name Illini Skyriders in tribute to the University of Illinois football team, the Fighting Illini. The club is divided among ultralights, grandfathered N-numbered ultralights, and light amateur-built aircraft. We have private pilots, sport pilots, a few perennial student pilots, and some uncertificated ultralight pilots.

For the majority who haven't experienced it, there is nothing quite like going on a cross-country flight on a beautiful day with a gaggle of friends in their aircraft. Like many other ultralight chapters, our group includes Quicksilvers down among the corn tassels flying 45 mph, Quad City Challengers and Kolbs at 1,500 feet flying at 60 mph, and light-sport aircraft above them, all communicating on the radio. There is nothing like it, and every flight is an adventure. It is the low entry cost of light-sport aviation that makes group flights possible, and where can you find this except with a chapter or flying club?

A club struggling to maintain membership and anyone starting a new chapter should consider three things that help a chapter succeed. They are food, family, and flying. You need food to bring people into your events. You need family to fill the ranks and provide the ground support, and you need flying, actual flying, at chapter events to make it exciting.

Food brings opportunities for social interaction and connection. Our chapter met the first few years on a weeknight in a conference room, but members had to grab food quickly before the meeting or go out afterward. That practice evolved into meeting in restaurant banquet rooms, and we still do that in winter. We always have food at meetings because it brings in the second secret, which is the family. The spouses, children, and grandparents of chapter members join in the festivities and become more involved. We have potluck picnics, order in pizza or barbecue, convoy to a restaurant, and have breakfast fly-ins. If the food quality is a step or two above brats and hot dogs, more family will attend.

PHOTOGRAPHY COURTESY OF DAN GRUNLOH

After you have food and family the third element is flying. It helps to have chapter gatherings on the weekend at a flying field because that is where aviation happens. It is not happening after dark in some conference room. Families get together on weekends to watch parents or grandparents fly with friends. You need decent facilities to attract family members to chapter events. Some of us would be happy with some old lawn chairs assembled in a gritty hangar, but it needs to be clean and comfortable enough for the families, with restroom facilities and heat or air conditioning if required. It should be comfortable and safe for the kids. It can be as simple as picnic tables on the lawn under a shade tree.

It's great to have a chapter hangar or club house for a home base of operations, but for some small chapters like UL30 that never happened. We meet at different locations every month so food arrangements run the gamut. Moving the meeting around to various locations provides additional interest to improve attendance. Quite a few of our members have their own sod private airstrip out in the country, and we arrange to have breakfast fly-ins or lunchtime potluck picnics for our monthly Saturday meetings. We welcome all aircraft, but sometimes we meet at private ultralight airstrips as short as 800 feet.

There should be a regular monthly meeting, even if there is no urgent business. It is the excuse to get everyone together so they can interact and helps develop a sense of group identity. I find that if we suggest skipping a formal meeting at one of our picnics because there is no important business, the members complain. They come to enjoy the food, see their friends fly, and sit in on the meeting, which is mostly builder reports and storytelling.

If a chapter is large and has a lot of club business, the officers or executive board should take care of more of it. Not all club gatherings have to be formal meetings. You can have both. It's better to minimize the time spent talking so as to maximize the time for socializing and flying. Newcomers will not be attracted by long debates about Robert's Rules of Order for parliamentary procedures. Keep it fun and recognize achievements of the members.

It's normal for chapters to come and go as people move around and demographics change. Sometimes when a chapter shrinks and fades away it's said to be caused by a lack of leadership. I believe anyone who can be a pilot can also be a leader. It takes the willingness of a few members to simply put in the effort to keep it organized and going. A monthly newsletter is also helpful, and perhaps the newsletter editor is the most important officer.

EAA's chapter manager, Brett Hahn, wants to help more members get the chapter connection. He is from Las Cruces, New Mexico, where he has flown everything from sailplanes to a Starduster biplane, with hang gliders and ultralights in between. He has seen firsthand what chapters can accomplish and has a lot of great ideas for chapter activities. Contact Brett at EAA headquarters for advice on how to kick-start your local chapter, or start a new chapter if you don't have one. It's well worth the effort. EAA

Dan Grunloh, EAA 173888, has been an EAA member and volunteer since 1981, and he has logged 1,500 hours in ultralights and light-sport aircraft. He can be reached at *dangrunloh2@gmail.com*.

Even the littlest kids want to be pilots.

Group photo of pilots at a chapter fly-in in front of a Murphy Renegade biplane.

Too young for Young Eagles, but old enough to sit in an ultralight.

PHOTOGRAPHY BY **DARIN LACRONE**

Mini Moth

Identifying the Bradley Special

BY HAL BRYAN

Ted Goble, EAA 6734, the current proud owner of the Bradley Special.

The panel is simple and honest, with a respectably vintage feel.

A small section of the trailing edge of the wing is hinged to make it easier to get in and out of the cockpit.

WHEN TED GOBLE, EAA 6734, flew his airplane at Oshkosh last year, everyone he talked to had two questions: What is it, and where can I buy plans? The answer to the second question is disappointingly easy: You can't, because there aren't any, at least not yet. As for the first question, that requires a little more explanation.

At first glance, it looks like it might be a Fly Baby biplane conversion, but that beautiful de Havilland rudder gets you thinking that it pretty much has to be a Fisher R-80 Tiger Moth replica. But then you look again and realize it's just a bit too small, and there's only the one seat. If you run the registration, it comes back as a 1996 DH-82A 70 percent Replica Tiger Moth, but that's not really what you'd call it now.

So, enough already—what is it? It's now known as a Bradley Special, in honor of the designer and builder, the late Wes Bradley. Wes was a machinist with, apparently, a real talent for aircraft design. He started the build in the late '80s while living in California, and then brought it with him when he moved on to idyllic Whidbey Island in Washington state.

When Wes originally built the airplane, it was quite a bit larger, something like 85 percent scale, powered by a 40-hp Morris Minor engine. It looked good, but it was heavy and couldn't get out of ground effect, so Wes decided to make some modifications. First, he shortened the fuselage by 3 feet, and then did the same to each wing, reducing the wingspan to 21 feet. The delightfully British Morris Minor engine was replaced with a 40-hp two-cylinder Volkswagen engine built by Mosler and sporting Scat heads.

Unfortunately, Wes ran into health issues as he finished the 10-year build and wasn't able to fly it, so the miniature Moth was put up for sale. A year later, it was parked at the Arlington, Washington, airport, and that's where Joe Kirner, EAA 440143, first spotted it. Joe, a Navy vet who served on P2V Neptunes and then started a gas station turned lawn mower repair shop that he built into one of the region's pre-eminent automotive tire businesses, was intrigued.

He asked the familiar question—what is it? Wes explained that it was a 70 percent scale Tiger Moth, and that he thought it hadn't sold because it was a one-off and largely unproven. In the best EAA spirit, Joe thought this a virtue, not a vice, and, after careful inspection, flew the airplane then and there. After landing, he bought it on the spot and was the proud owner of a unique little biplane with all of 15 minutes' total time on the engine and airframe. It was at that point that Joe decided the airplane was now a Bradley Special, a wholly appropriate homage to the man behind it.

When Joe asked Wes if he could get a copy of the plans, Wes handed over a single sheet of paper—the instruction sheet from a model Tiger Moth. Wes started there and just scaled things up, trading stick-and-tissue for a steel tube fuselage with wood wings. As he was building it, though, he introduced a number of design refinements. First, he built a hinged section in the center of the top wing. This allows several inches of the trailing edge to fold up and forward to make getting in and out of the cockpit that much easier. Intentional or not, this is very reminiscent of similar structures on de Havilland's Leopard and Puss Moth

PHOTOGRAPHY BY **CAITLIN KILEY**

But then you look again and realize it's just a bit too small, and there's only the one seat. If you run the registration, it comes back as a 1996 DH-82A 70 percent Replica Tiger Moth, but that's not really what you'd call it now.

designs, though those were built to facilitate folding wings. Speaking of which, Wes built a wing-folding mechanism into the Bradley Special as well. There's nothing too uncommon about that, of course, except that it eliminates any issues you might normally find given the stagger of the wings. When it comes time to fold the wings for trailering, you pull the pins and then the lower wing slides forward about a foot so that the pivot points line up exactly. At this point, the wings fold back neatly and in perfect alignment.

Wes' original approach to the pitch trim system was also interesting. Rather than using a trim tab, he took his cue from Cubs and numerous other vintage types and built a mechanism that raises and lowers the leading edge of the horizontal stabilizer, changing the angle of incidence. The system differs from the Cub's, however, in that, rather than using a jackscrew, he went with a simple bell crank mechanism connected to a large handle in the cockpit.

When Joe bought the airplane, it was considered a "fat ultralight," back when there was such a thing. That wasn't an insult; in fact, the airplane won Grand Champion Ultralight and Best Mixed Construction at Arlington in 1995. Joe owned and enjoyed flying the airplane for several years and then, in 2010, tore it apart and rebuilt it. As the project progressed, he made some progress toward drawing up plans, and at one point, he considered building a second Bradley Special, but focused on the restoration instead. As for those plans, Joe is well aware that there's a demand for them, so it's still possible that he'll finish them up and make them available. Time will tell.

Joe finished the airplane, adding a gel-cell battery-driven electric starter—he's been bitten, thankfully not seriously, twice by hand-propping various airplanes over the years—and upgrading the powerplant to a 65-hp 1,915 cc four-cylinder Volkswagen engine built by Scott Casler, swinging a 58-by-32 Tennessee prop. That's the airplane that caught so many eyes at AirVenture Oshkosh in 2015. But Joe, whose friends call him by the portmanteau "Joker" and describe him as the "spark plug" of his EAA chapter (404 in Lynden, Washington), is one of those guys who really isn't happy unless he has a project to work on. He bought a Challenger on floats and then rebuilt it after it

ended up upside down in a lake, built two Fisher 404s, and a highly modified Fisher Avenger. His most recent project, perhaps coincidentally, perhaps not, is another miniature Moth, a salvaged Fisher R-80 80 percent scale Tiger Moth replica.

With the new Moth to work on when he isn't flying the Avenger, Joe decided to sell the Bradley Special to Ted, who is a former United Airlines pilot who started on the DC-6 and retired on the 747-400. Ted had wanted the airplane for some time, so he was very happy to snap it up and take it home to his 1,200-foot grass strip in Custer, Washington. As Ted said, "I enjoy this little airplane the most of any I've owned."

If for some reason you didn't fall head over heels for this airplane the moment you saw it, you'd likely change your mind if you spent a minute or two listening to Ted. "I've always used my airplanes mostly to go places," he said. "Coast to coast, and up and down both coasts done low-and-slow, tent camping under the wing. Great fun…but those kinds of airplanes may be a little too much for just the 20-minute flight at sunrise or sunset, or both the same day!" He described the airplane as easy to get into and said that, combined with its light weight, "contributes to the feeling of just 'grab and go.'"

The Special is well-mannered on the ground with great visibility—no S-turns required. Ted says that the steering is "just as positive as a nose wheel, and the little MATCO tail wheel swivels to let you spin it around into the tiedown." Once you've leveled off, the view behind is unobstructed, and the size and placement of the wings mean that forward visibility is equally impressive. Ted has flown a full-scale Tiger Moth and says that the Special flies much like its older ancestor. He describes the ailerons as being a bit heavier, but the rudder is light with a lot of authority, so it feels "light and sprightly, and not the least bit twitchy or ponderous." In power-off stalls there's no break, just a gentle descent at around 45 mph indicated. With power on, there's a break he calls "mild," and no tendency to drop a wing. The little biplane climbs and glides at 50 mph, and will cruise at 75, though Ted usually flies at 65, sipping all of 3 gallons of mogas every hour. Landings, he says, are a "nonevent, with the positive, direct-drive rudder."

Ted didn't fly his miniature Moth to Oshkosh—it made the 2,000-mile trip in a trailer, with a few days' detour at Brodhead, Wisconsin, both inbound and out—but he flew it *at* Oshkosh, nearly every day, and that's the important bit. If you saw it here last summer, you likely remember it, and fondly. Watching it motor overhead, its pleasing lines are to a full-scale Tiger Moth what a kitten is to a cat: immediately recognizable, but still sort of wide-eyed and utterly charming. Its honest elegance conjures visions of flying "out of Africa"— a scale model of Africa, that is—alongside a tiny Meryl Streep. Yes, you'd have to take the sweep out of the wings to make it look more Gipsy than Tiger, but it's still a wonderfully evocative little time machine.

Now, how about those plans? EAA

Hal Bryan, EAA Lifetime 638979, is senior editor for EAA publications and a lifelong pilot and aviation geek. He's logged time in a variety of types, most of them old and weird, and he wouldn't have it any other way. Find him on Facebook at *www.Facebook.com/halbryan* or e-mail him at *hbryan@eaa.org*.

BRADLEY SPECIAL

Crew: 1
Wingspan: 21 feet
Length: 17 feet 5 inches
Height: 6 feet 4 inches
Width (wings folded): 8 feet
Powerplant: 1,915 cc four-cylinder Volkswagen 65 hp
Fuel capacity: 6.5 gallons
Empty weight: 435 pounds
Gross weight: 700 pounds

Above: Designer and builder Wes Bradley's original proof-of-concept model built to test the wing folding mechanism. Below: Some people wouldn't like the sight of an airplane in the driveway. We are not those people.

Dr. Chapenoire piloting his CP-320. You don't see many of these planes flying in the U.S.

Photo Credit: François Maurisse

French AME Uses Claroxan Advanced

Pacific Health partners with Aviation Medical Examiners (AME) to help educate folks in the aviation community on the benefits of Claroxan - the supplement for healthy eyes.*

Dr. Stephane Chapenoire is an AME located in Bordeaux, France. He has been taking Claroxan on a regular basis every day since April 2011.

One thing that appeals to Dr. Chapenoire about the Claroxan formula is that it contains ingredients that are recognized by the European Food Safety Authority (EFSA) as being beneficial for the health and maintenance of the eyes.

In the USA supplements are not regulated by the FDA and health claims substantiated by scientific and clinical research can be made without a government approval process. In Europe, however, the regulations are more strict. The EFSA requires specific authorization for a food or supplement ingredient to be approved for health claims regarding how it may support or enhance a body part.

The good folks at Claroxan visited Ireland, Great Britain and the Netherlands in November of 2013 to learn about these regulations and visit potential partners in their quest to bring better eye health to more parts of the world.

Now back to Dr. Chapenoire and his love of aviation. He co-owns a CP-320 Super Emeraude with two other lucky pilots. The plane is based at the Léognan-Saucats Airport about 10 NM south of Bordeaux. He makes sure to fly it at least once a week to keep his piloting skills sharp.

We talked to Dr. Chapenoire about his success with Claroxan and this is what he had to say:

"I first read about Claroxan in AOPA Pilot magazine and have been taking Claroxan Advanced regularly for more than four years now.

I have found during this time my eyesight has greatly improved in both day and night vision. My eyes feel less tired and more comfortable.* I would happily recommend this product to others."*

YOUR WORLD, IN FOCUS

Pilot Preferred

Aviation professionals trust Claroxan to support and maintain healthy eyesight.*

Ted Fields

"I took Claroxan for a year and visited my doctor. My left eye got better and my right eye stayed the same. My wife was having some problems with her vision so I started her on Claroxan too. Nothing compares to Claroxan."*

Joe Hopkins

"I started using Claroxan daily in June of 2013 and on my most recent 2nd class medical test I was able to pass the color portion! I am 62 years old this July, working on my CFI and can't wait for my check ride."*

Roger Johnson

"I started using Claroxan for peace of mind. I take my flight physical every six months to renew my first class medical and continue to receive 20/20 on the vision portion, which astounds my examiner. He asks me how I do it and I say, 'In addition to a healthy lifestyle, I take Claroxan daily.'"*

John Sylvester

"I started taking Claroxan to preserve my eyesight. At 53 it is something to consider and with my profession it is important to keep that in mind. I noticed during my last medical exam that my near vision was clearer and that's really essential to getting things done quickly and accurately in the cockpit."**

*These statements have not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, treat, cure or prevent any disease.

I'm a **Young Eagle**

No one in her family flew, but that didn't stop Michaela Goldammer from deciding at 10 that she would be a pilot.

"I was always talking about flying to people," said Michaela, now 19, of Blacksburg, Virginia. "That's how I heard about Young Eagles and EAA."

In February 2012, the then-15-year-old took a free Young Eagles flight. A few months later, Michaela received a scholarship from EAA Chapter 1426 to attend a weeklong aviation camp at the National Flight Academy at Pensacola, Florida.

Michaela used the free Sporty's Learn to Fly course offered through Young Eagles and started her flight training in March 2013. She soloed in October 2013 at 17, and in January 2015, at 18, Michaela earned her private pilot certificate.

Michaela is now a student at Virginia Tech, where she is majoring in electrical engineering, and also plans together A&P mechanic rating.

"Learning to fly has shaped my life in so many ways," Michaela said. "It has put things in perspective, and made me realize that I shouldn't give up…From the bottom of my heart, I am so grateful to EAA and Young Eagles."

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Accident Report 2015

BY RON WANTTAJA

WELL, AS WE FEARED, last year's results didn't start a trend.

That report covered experimental amateur-built (E-AB) accidents for the five years ending in 2013. It looked like the number of accidents had started to decrease.

But, as we discussed last year, statistics "wobble." Sometimes it's just random; sometimes an exterior force (such as gasoline prices) has a hand in it.

The year 2014 saw 184 E-AB accidents, an increase of more than 20 percent from 2013. However, as Figure 1 shows, 2014 really only returned to a more typical number of accidents, compared to the previous four years. Preliminary data for 2015 shows the number down, slightly.

CAUSES: 2014 VERSUS 2013

Figure 2 illustrates the major differences in the causes of E-AB accidents for 2013 and 2014. The first thing that jumps out is the increased number of accidents that began with engine stoppage. Sixteen more accidents, almost a 40 percent increase!

The number of instances of engine mechanical failure was identical, but most other causes increased. There were more cases of fuel exhaustion and starvation, more cases of carburetor icing, and more cases where the NTSB was unable to determine the cause of the engine failure. The increase appears to be just normal year-to-year variation.

Pilot miscontrol (stick-and-rudder errors) remained about the same, but pilot judgment-related E-AB accidents nearly doubled in 2014. Some of those (fuel exhaustion/starvation) overlap the power loss category, but 2014 also saw an increase in accidents due to maneuvering at low altitude. Power lines and low-altitude stalls are the *bête noire* of the buzzer; too often pilots don't avoid one or the other.

Otherwise, nothing really stands out. Most categories show a few more accidents, but other than those above, it's pretty much a general increase across the board. The homebuilt fleet probably flew more in 2014 (the reduction in gasoline prices probably helped), and when the airplanes fly more, the accident rate increases.

DO THE WINGS *REALLY* FALL OFF?

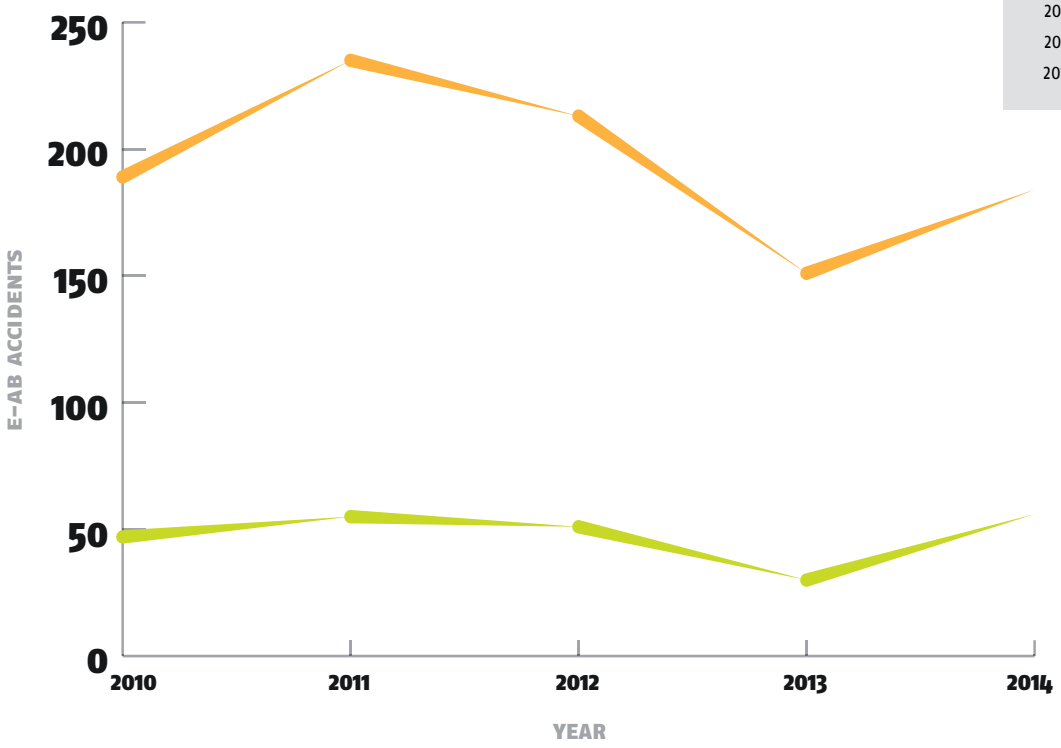
I might have about 51 cause categories in my accident database, but when I talk to nonpilots and say I fly a homebuilt aircraft, one cause seems to be the first one they mention:

"Aren't you afraid the wings are going to fall off?"

Well, *should* we be worried? Let's take a look at airframe structural failure over the entire period of my records, 1998 through 2014.

Breakage of the airframe itself is a relatively rare event, but every year does rack up one or two accidents. About 1.7 percent of homebuilt accidents involve airframe failure. As

FIGURE 1: HOMEBUILT ACCIDENTS OVER PAST FIVE YEARS



YEAR	TOTAL ACCIDENTS	FATAL ACCIDENTS
2010	189	47
2011	235	55
2012	213	51
2013	151	30
2014	184	56

Figure 3 shows, almost 75 percent of those affect the wing or its bracing system.

Why do the wings fail? Figure 4's results are pretty scary: In almost half the cases, it's due to overstress.

Out of the 17 overstress cases in my 1998-2014 database, 10 involved deliberate aerobatics. Half were purpose-built aerobatic designs; another three were common sport designs where the designer has approved aerobatics.

Other than the one nonaerobatic airplane of the group, only one case included reference to construction or maintenance issues related to the wings. In all the rest, the NTSB laid the probable cause on the pilot.

In the nonaerobatic cases, builder error was mentioned as a contributor about 30 percent of the time.

AIRFRAME FAILURE IN PERSPECTIVE

One thing to remember: The NTSB database only records accidents. Cases where the pilot is able to successfully land often aren't included. Obviously, a wing or strut failure is more likely to actually cause an accident and end up on the record. But, even among the reported cases, not all result in injuries or even loss of the aircraft.

While the nonaviators may focus on "wings coming off," it really doesn't occur that often. In the 17-year time period of

PROCESS

Basic source of the data is the downloadable NTSB accident databases. The accidents flagged by the NTSB as "homebuilt" are cross-referenced with the FAA registration database to determine the actual certification status of the aircraft. Those certificated in other than E-AB category are eliminated, as are unregistered or foreign-registered aircraft. The "purpose of flight" entry in the accident database is used to weed out air show, racing, and other uses not typical of personal E-AB operations.

In addition, the remainder of that year's accidents are examined to find E-AB aircraft that were not labeled as "homebuilt" by the NTSB but certificated as such by the FAA. There were 11 such cases in 2014.

Thus, totals presented here do not exactly match the official tally.

After the E-AB aircraft have been identified, the NTSB data is examined to determine the cause of the accident. The NTSB narrative report is used to determine the first major event (the "initiator") of each accident. This conclusion may differ from the NTSB's final "probable cause" ruling. For example, if the engine fails and the pilot stalls during an attempted forced landing, NTSB probable cause will be pilot error. As amateur-built aircraft have a greater tendency toward mechanical issues, tracking the initiators rather than NTSB probable cause results in better understanding of hardware problems.

The initiators are tracked in 51 separate categories. Where more than one factor is involved, these subsidiary factors are also recorded. The accidents are maintained in a database currently covering 17 years (1998 to 2014, inclusive).

my database, there were 62 instances of airframe failure. In the same time period, engine mechanical failures occurred 869 times. Your aircraft is *14 times* more likely to suffer a mechanical failure of the engine than structural failure of the airframe.

However, Figure 5 holds a scarier story. When airframe failure occurs, the fatality rate is more than 60 percent—more than four times that of accidents that occur due to mechanical problems with the engine.

The reason should be obvious. When the engine fails, the response is (usually) flying an otherwise-functional airplane down to a dead-stick landing. Much of our training is focused on performing that one maneuver; it's stock in trade on our flight reviews. If luck is with us and we keep our heads, it's quite likely we'll survive the experience.

But airframe failure is almost impossible to train for. Often, the aircraft itself is uncontrollable. Barring a parachute, it's a tough one to survive. And even then, well, those 10 cases

FIGURE 2: CAUSE COMPARISON: 2013 VERSUS 2014

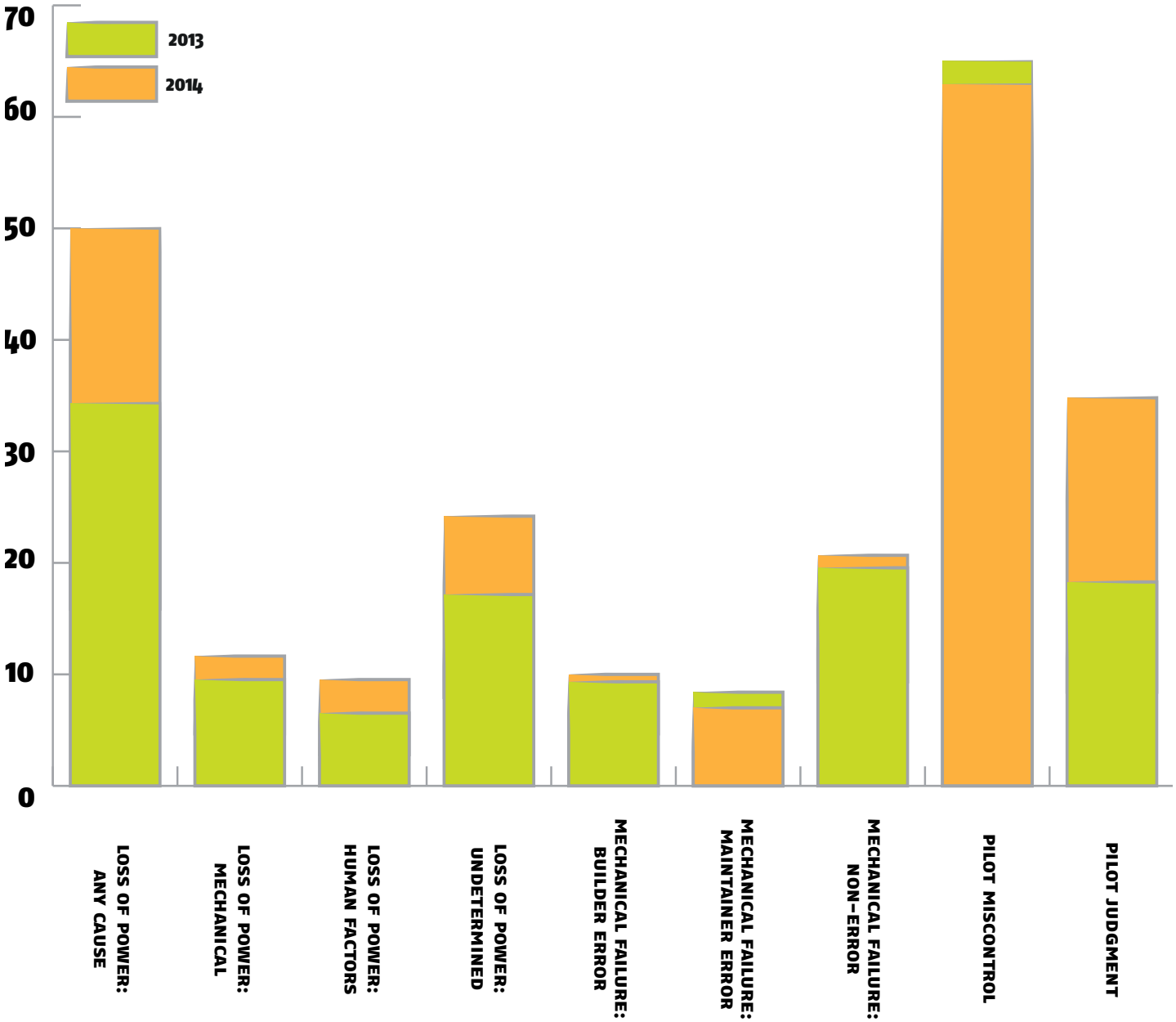
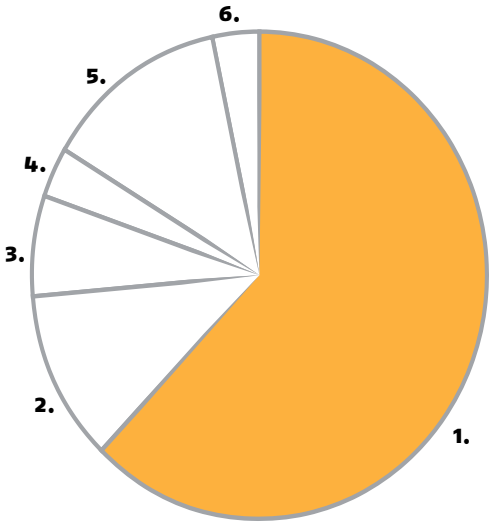
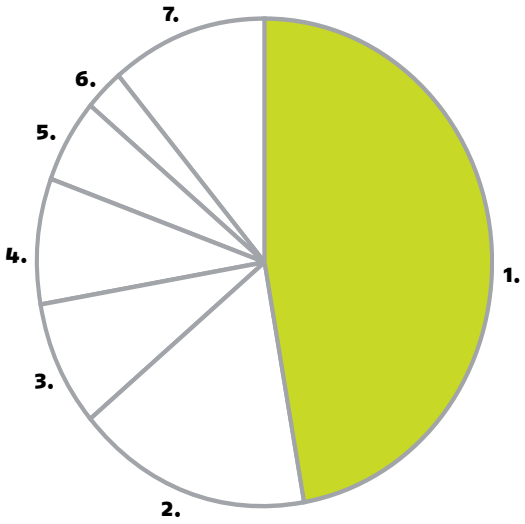


FIGURE 3: TYPES OF AIRFRAME FAILURE



WING (1)	62.3%
STRUT (2)	11.5%
FUSELAGE (3)	6.6%
COWLING (4)	3.3%
TAIL/CANARD (5)	13.1%
ROTOR (6)	3.3%

FIGURE 4: CAUSES OF WING FAILURES IN E-AB AIRCRAFT



OVERSTRESS (1)	17
IMPROPER INSTALLATION (2)	6
BOND FAILURE / DETACHMENT (3)	3
IMPROPER MATERIALS (4)	3
FLUTTER (5)	2
MODIFICATIONS (6)	1
UNKNOWN (7)	4

of overstress failure during aerobatics? Only three pilots successfully bailed out. One landed the plane successfully. The rest died.

Aerobatics is a marvelous sport, but it does entail higher risks than $100 hamburger runs. Wearing a parachute is a fundamental safety precaution, but the ability and willingness to use it if necessary is just as important. A U.S. Navy aviation safety poster of the '60s showed a flaming F-8 Crusader dropping off the "angle" of a carrier with pilot ejection already in progress. The caption: "Know when to go, then GO!" Good idea for the light aerobatic flier, as well.

SUMMARY

E-AB airframe structural failure, thankfully, is reasonably rare: less than 2 percent of the total number of accidents. While overstressing the wings is the largest single component, there are still other causes to watch out for. Thirty percent of the accidents involve builder error, but owners of older aircraft must watch out for corrosion, delamination, rot, and fatigue. About a tenth of the airframe-related accidents involve these factors.

2014 was a typical year, homebuilt-safety wise. From the five-year trend data in Figure 1, it appears the accident rate is flat—almost the same number of E-AB accidents in 2014 as in 2010. With an average of 1,000 new homebuilts added to the rolls every year, this is, effectively, a reduction in the accident rate.

Why the heat, then? Why all the attention from the FAA about the homebuilt accident rate?

TALLY WOES

I found a total of 184 experimental amateur-built accidents in 2014. Other sources are reporting a lot more accidents. If you run the NTSB online database with the "amateur-built" flag enabled, you get 224 accidents. Why do I show 40 fewer E-AB accidents?

It's simple, really: The "amateur-built" flag on the online database usually indicates aircraft with nonstandard airworthiness, not just experimental amateur-built aircraft. Of the 224 aircraft in the official results, more than one-tenth (23) were certificated as experimental light-sport aircraft (E-LSA). In addition, another 11 aircraft flagged as "amateur-built" were uncertificated Part 103 air vehicles.

Why does this matter? Because these records are being analyzed by government and nongovernment entities, and recommendations are being made for alteration of policies affecting experimental amateur-built aircraft. E-LSA and ultralights are not constructed and inspected by the same standards used for E-AB aircraft. Accidents affecting these aircraft should not be used to formulate E-AB policy.

Ideally, the NTSB should eliminate the "homebuilt (Y/N)" flag in its databases and replace it using the same two-digit code the FAA uses to record certification in the registration databases.

Figure 6 shows the public face of the accident story: From 1998 through 2014, the overall number of aircraft accidents has dropped by about 38 percent. E-AB accidents have dropped, too, but at less than half the rate.

This is the sort of thing that catches the FAA's attention. But in-depth analysis shows a different picture. While the overall number of aircraft registered in the United States has dropped by about 30,000 since 2000, the homebuilt fleet *increased* by more than 4,600 aircraft over the same period. The annual fleet accident rate for E-AB in 2000 was almost identical to that of 2014 (34 percent versus 35 percent). So the number of E-AB accidents didn't drop like the overall rate because more airplanes got added to the fleet. And, despite the addition of 4,600-plus aircraft to the rolls, the actual number of E-AB accidents decreased.

Good news all around. While this alleviates most of the concerns raised by the relative statistics, one sad factor does remain: The average annual E-AB fleet accident rate is still about 30 percent higher than the overall rate. If nothing else, this will keep us under the FAA's safety microscope.

Irrespective of the accident rate, making homebuilt aviation safer is a worthy goal. Fly safely in 2016! EAA

Ron Wanttaja, EAA 275698, is the author of two aviation books, *Kit Airplane Construction* and *Airplane Ownership*, as well as two young adult historical novels and numerous magazine articles. He owns a 1982 Bowers Fly Baby and maintains a web page for devotees of the design at *www.BowersFlyBaby.com*.

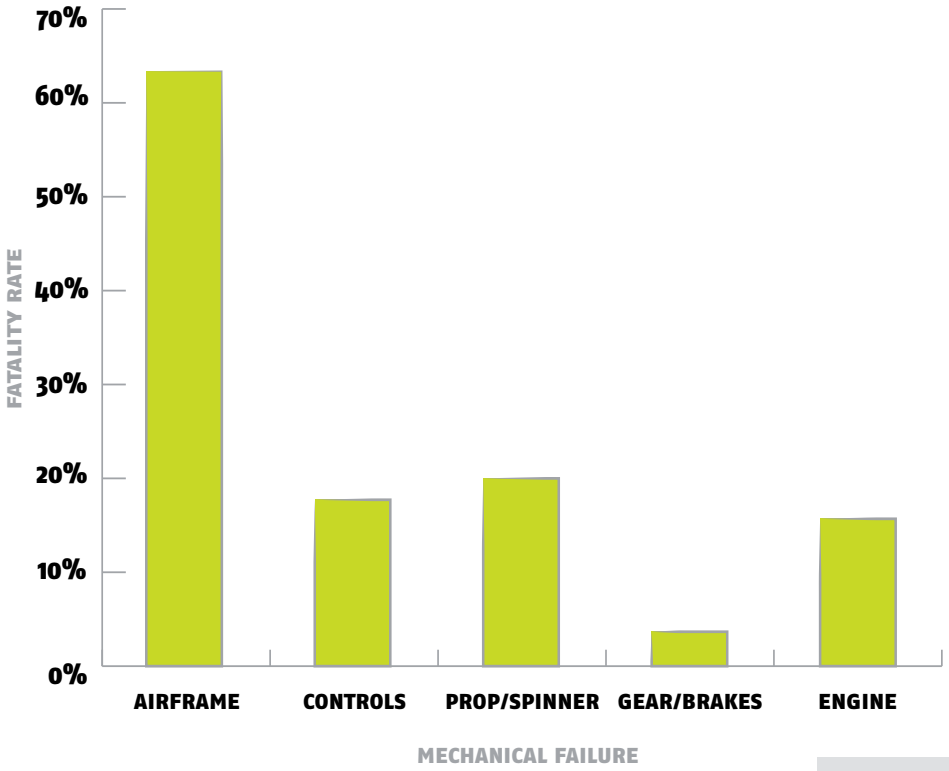


FIGURE 5: FATALITY RATES FOR MECHANICAL FAILURES

AIRFRAME	62.9%
CONTROLS	18.6%
PROP/SPINNER	19.7%
GEAR/BRAKES	3.6%
ENGINE	16%

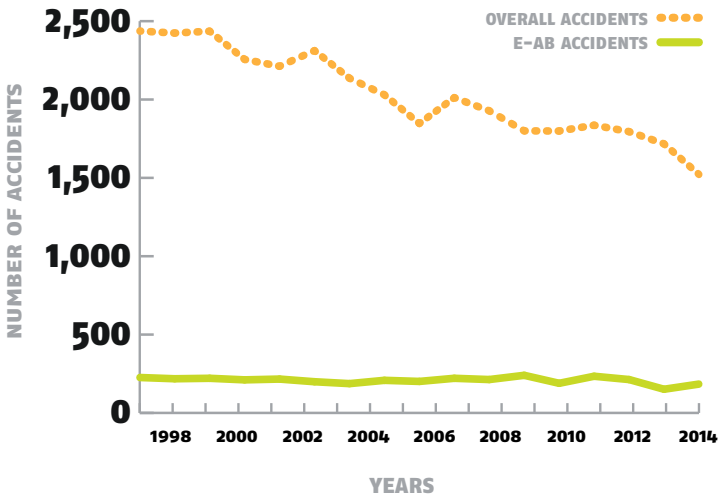


FIGURE 6: U.S. AVIATION ACCIDENTS SINCE 1998

YEAR	E-AB	OVERALL
1998	226	2,437
1999	218	2,424
2000	221	2,436
2001	211	2,256
2002	216	2,212
2003	199	2,312
2004	187	2,136
2005	208	2,030
2006	201	1,847
2007	221	2,012
2008	213	1,926
2009	240	1,800
2010	189	1,799
2011	234	1,836
2012	213	1,795
2013	151	1,717
2014	184	1,522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EVERYONE STARTS SOMEWHERE

Building with the minimum

BY BUDD DAVISSON

THIS TIME WE'RE TALKING to the absolute newbies out there. I'm picturing a 21-year-old newlywed with a baby on the way, a building space that is the back part of a single-car garage behind their tiny rental house (or maybe a bedroom in their apartment). He's doing his best to put away a little savings from his first full-time job, and the paychecks are too far apart. You know the guy. He is us from back in the day. Back when the aviation passion bug had burrowed deep, and we wanted so badly to build an airplane, but everything was against us. That's who I'm talking to.

The reason I wanted to clear that up is because in the interest of getting deeper into the art of low-buck airplane building, I'm going to expand on a few subjects (specific tools and techniques) I've mentioned earlier. This is being done in the interest of showing our fictional newbie that he doesn't need a ton of tools to build an airplane. In fact, for $200 we're going to equip him so that he can at least get started building an airplane. Another $300 or so later on will set him up to where he can build an entire tail, fuselage, and landing gear of any number of popular homebuilt airplanes for nothing more than the cost of materials. Then through sweat equity, he can build the wooden wings.

A caveat: By eliminating certain common tools he's going to be trading elbow grease and time for the money he doesn't have. He'll also wind up without some of the niceties; for instance, he'll be brushing paint on tubing rather than spraying it. This in exchange for the air compressor and spray gun he doesn't have to buy. You'd be surprised how well some paints flow out and don't look as if they were brushed. The goal is to get him into the air with the absolute lowest cost, so finesse and finish is going to be sacrificed.

We're envisioning some sort of super basic airplane like a Pober Pixie or maybe a Stewart Headwind. Both are airplanes where money can also be saved via converted VW engines, which results in economical operation and less acquisition cost. Both are also rag-and-tube fuselages with simple rag-and-wood wings.

First, let's look at the types of operations we're going to need to do when building a generic fuselage.

The first thing that comes to mind is cutting and fitting the tubing. There are probably a dozen ways to cut the tubing, beginning with a hand hacksaw and ending with a CNC water jet or laser. But the name of the game here is to save a buck: Don't forget about the new mouth our young homebuilder will soon have to feed.

The hand hacksaw is certainly cheap enough, but it's slow and can only do one thing: cut straight lines. So, what's the next cheapest alternative that has more applications? My vote is for my all-around most-favorite and most-used steel-working tool: the 4 or 4 1/2 inch angle head grinder ($21 at Harbor Freight, Makita 4 1/2 inch at Home Depot, $59).

The angle head grinder is a form of hand-held machine shop in that you can cut, shape, or smooth almost anything made of steel. It goes through tubing like butter (it's essentially a hand-held cut-off machine), you can easily direct it to cut any angle, and it will even let you finesse the cut into a gentle curve to help with the final fitting. Further, on tubing you can make a slight V-cut on both sides of the open end, so using a rasp or bench grinder for the final fitting is a short-lived operation.

Because the fittings in little airplanes are never much more than 0.062-0.090 inch thick, a cutoff wheel in an angle head grinder can rough-cut a fitting to shape in nothing flat. The only caveat is that they cut by abrasion and so are effectively burning their way through, which toasts the metal on both sides of the cut, as indicated by the blue color. If that edge is going to be welded, this can be ignored. But, you really don't want to burn the metal next to a hole or on an edge that won't be welded

because it changes the makeup of the metal for a short distance. When cutting a fitting with a cutoff wheel in the angle head grinder, cut a little wide of the line and sand it back to shape. The really good part about this is that we can use the same angle head grinder with a sanding disc or, better yet, with a flapper sanding disc to cut it back to the desired line. Go slowly and make long, smooth passes on the straight edges in an effort to make them straight. Don't burn the edge. Finish them off with a high-grade file (Nicholson) and a sanding block.

The flapper sanding discs used on an angle head grinder are one of mankind 's greatest inventions! It is absolutely

Here it is: the entire collection of tools required to build a tubing fuselage, tail, and landing gear. Only welding gear (about $350) needs to be added, when it's needed. Note: cut-off disc in the angle grinder and the flapper sanding disc in front. They're magic at working steel!

PHOTOGRAPHY BY **BUDD DAVISSON**

amazing how easily they shape steel. In fact, they do it so easily that you'll have to develop a light touch on the thin material in airplanes or you'll be taking away metal that you wish you hadn't.

Right now you're thinking that we should just buy one of the low-buck, 4-by-36 stationary sanders that are so readily available on the market. Harbor Freight has one that works nicely for $84. However, when we say that, it means we've forgotten that when you're young and living paycheck to paycheck $84 looms large.

Once we've cut the tubing, we have to cut a concave radius into the end that lets it nestle into the adjoining piece of tubing. There are lots of ways to do that, too, ranging from hand filing to CNC nibblers. One of the most common ways is with a bench grinder. Some folks radius the grinding wheels to match a specific size of tubing, and it works well and you don't need anything bigger than a 6-inch grinder ($40 from Harbor Freight).

Battle-scarred DIY vise blocks hold tubing secure with no marks on the tube. They are made from shipping skid scrap and have been in service about 40 years. The base of the front one inside the vise is curved to allow it to align with odd shapes. It took 45 seconds, including changing from a cut-off disc to a sanding disc, to contour the tubing end.

Another equally as fast and much cheaper method is to just use the super-coarse, 18-inch and 5/8-inch round rasps that are sometimes found at welders shops.

When working the tubing (and plate), we're going to have to have a way to hold it, i.e., a vise, of sorts. We could clamp the tubing to the bench top, but with vises being so cheap ($25-$60 on Amazon.com) and since we're going to need one for other operations, it doesn't make sense not to buy one.

Once you have the vise, we're going to build wooden "vise blocks" for it that can hold the tubing without scratching it. A good source for the wood to do that is the the thickest wood on a shipping skid or pallet. Laminate those together to get about 3 inches thick. Clamp the two big blocks together and drill holes through the joint that are the same sizes as the tubing we'll be working so, when cut into an L-shape and put in the vise, they'll clamp the tubing. We'll also make saw cuts in them at 90, 45, and 60 degrees should we want to hand cut the tubing at an angle.

We're also going to need a drill to make holes in various airframe parts. On the fuselage it'll be mostly in fittings and tabs; however, in a tubing fuselage structure, there are only a few holes that demand any level of precision (wing fittings, etc.) and lots where precision isn't demanded, so a drill press, although it makes life easier, isn't really needed.

If you Google "90 degree drill guide" you'll find lots of apparatuses that will help. One of my favorites is from Lee Valley and only costs about 20 bucks. However, if you Google "drilling a 90 degree hole" the DIY community instantly offers lots of really neat ways to drill holes square to a surface.

So, what I'm saying here about holes is that it is perfectly possible to get by without a drill press, although having one makes life a million times easier ($70 Harbor Freight, $120 Sears). A decent 3/8-inch electric, corded hand drill will run about $35.

A COST SUMMARY SHOWS THE FOLLOWING:

- 4 1/2 inch Makita angle grinder	$50 (Amazon.com)
- 1/16 cut-off discs, three each at $2.50	$7.50
- flapper sanding discs, 20-pack	$20 (Amazon.com)
- 6-inch bench grinder	$40 (Harbor Freight)
- 3/8-inch corded electric drill	$35 (numerous sources)
- 4-inch bench vise	$40 (numerous sources)
Total	**$192.50 (reduce $50 with hacksaw)**

At some point an additional $300 or so will needed for a welding rig (Smith AW1A or MECO Midget torch) to stick the pieces together, but that can wait while the pieces are being cut and fitted.

If you wait for the perfect time to build, you may find that you run out of time and "someday" never comes. Life is a race against the clock, but we only know when it begins, not when it will end. So, don't wait. Even if you do nothing more than build a single elevator, having made that first step scratches an itch, and nothing spurs progress like mini-achievements do. EAA

Budd Davisson, EAA 22483, is an aeronautical engineer, has flown more than 300 different types, and has published four books and more than 4,000 articles. He is editor-in-chief of *Flight Journal* magazine and a flight instructor primarily in Pitts/tailwheel aircraft. Visit him on *www.AirBum.com*.

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FABRICATING A METAL STRUT FAIRING

BY TRACY BUTTLES, EAA 839196; EAA SAFETY PROGRAMS COORDINATOR

ON EAA'S ONE WEEK WONDER CH 750 Cruzer, we decided the time had come to clean up the exposed strut attach point with a fairing. Since it is an all-metal aircraft and still awaiting a paint job, I decided to make the fairing out of aluminum. So for those of you who are "afraid" of Fiberglas, here is a metal option for making fairings.

I started with some poster board, one of my favorite materials to work with. It replicates the thickness and stiffness of thin sheet metal and makes mocking up something like this simple. A scissors, masking tape, and Sharpie, and the possibilities are endless.

The idea with this fairing is to have the metal smoothly wrap around the strut and transition nicely to the wing. I started by cutting a rough shape with a small piece of poster board to wrap around the strut. Tape it to the position you like. If you are a little short on some of the edges, you can cut a small piece to tape into position, remove the template, transfer the shape to a new piece, and trial fit that one.

To keep the fairing together, I decided to attach the fairing to itself at the trailing edge. I added about 1/4 inch of material to the trailing edge and bent that a few degrees down to have an area to rivet together. I squeezed a few 3/32 rivets, but you can use aluminum pull rivets or small machine screws. If you plan on doing something like that, make sure to add a bit of material to the template.

Once you have the shape you like, transfer that to a piece of 0.020 aluminum. I have found that 0.016 is too thin and 0.025 makes it a little difficult to wrap to shape.

I used tin snips to cut to shape and a carbide cutting tip on my air die grinder to finish the tighter inside contours.

I have found that it works best to pre-bend the leading edge around some piece of round pipe or anything with a similar radius in the shop.

To attach the fairing to the wing skin, I pull-riveted a couple small L angles to the skin and bent them to match the angle of the fairing. Then I just riveted the fairing to those L angles. If you prefer, you can use nutplates and install with machine screws.

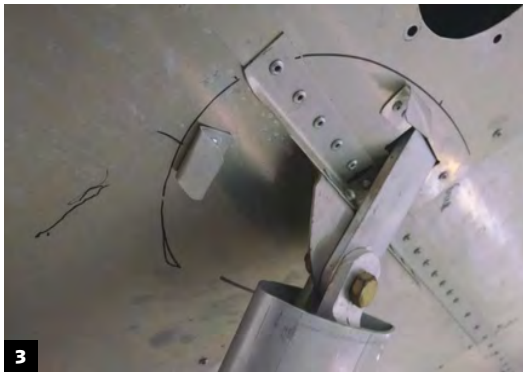
The upper edge of the fairing was trimmed off so it doesn't rub against the wing skin, and I had wrapped the lower edge of the fairing with a rubber edge material.

All in all, it is not that difficult to make simple fairings out of aluminum.

STEP BY STEP


1


2


3


4

LED LIGHTING

BY JOHN HEISER, EAA 403057; OWASSO, OKLAHOMA

I ALWAYS NEED additional lighting when using my power tools.

I found a sewing machine LED lamp for $15 on eBay with free shipping.

As you can see from the pictures the lamp head is attached to a gooseneck, and the magnetic base has the power switch.

I like the lamp so well I purchased an additional three units for other machines.

I liked John's idea so much I immediately ordered one from Amazon.com. I found a 10 LED light for $9.99. The 7-inch flexible gooseneck works great for my drill press.—Ed.

CLECO MARKINGS

BY JOHN BURNS, EAA 1040966; CONNERSVILLE, INDIANA

I THOUGHT I WOULD share an idea that I came up with while building my CH 750 STOL kit. When building a kit plane, there are times when you need to either rivet something at a later time or perhaps the holes do not get enlarged until another part is added. It can be easy (especially late in the day) to keep drilling or keep riveting and wind up with a rivet to drill out or a hole that was enlarged too soon. To help me remember to wait, I put some red zip ties on top of a few Clecos. When you put them around the top, the zip ties do not affect the ability to insert or remove the Cleco, and they can be easily moved if you need them on copper Clecos instead of black. EAA

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A MODEL MUSEUM COLLECTION

While only a few hundred are on display at a time, there are about 1,700 model and toy airplanes in the museum's possession. There are some more recent models and toys in the collection, but the oldest is the 1919 Aero Flying Model airplane, still in its original box. Ron Twellman, curator of collections at the EAA AirVenture Museum, said it's amazing that such an old piece is still in such pristine condition. One unique model the museum has is a metal XB-70 Valkyrie supersonic bomber that came from North American. "It actually has some mechanical features to it, all of which are not working, but the nose drops, the ends of the wings go down, and that's all operated by turning the exhaust on the engines," Ron said. On top of the hundreds of toy and model airplanes, the museum also has several model kits, both wood and plastic, that are still in the boxes.

PHOTOGRAPHY BY ERIN BRUEGGEN

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