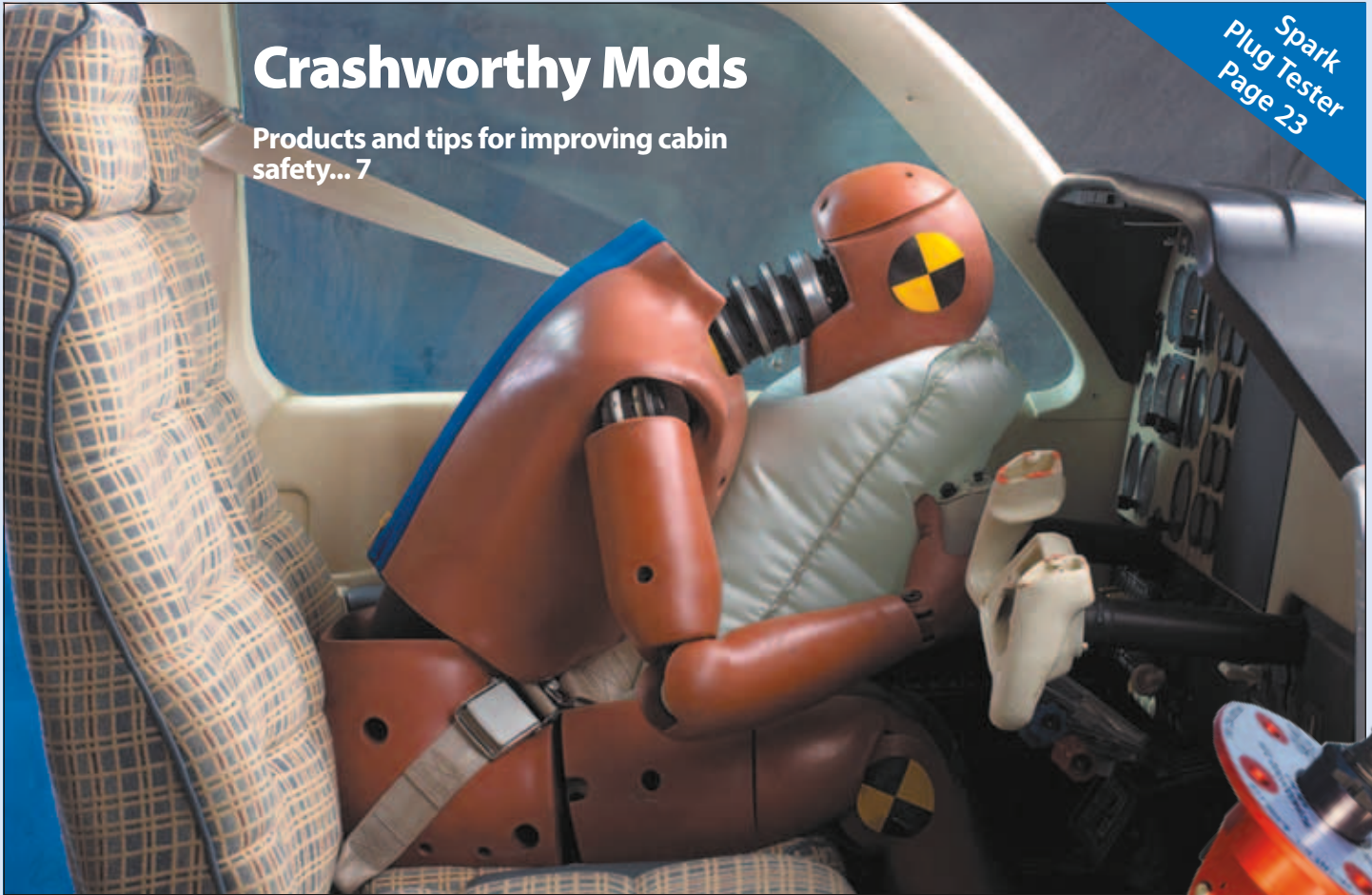


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FIRST WORD

DELETHALIZING THE CABIN

Just how crashworthy is your aircraft's cabin? Here's hoping you'll never find out. Our safety refurbishment article that begins on page 7 contains a number of useful tips for preparedness, plus a rundown of aftermarket products for raising the bar on cabin crashworthiness and occupant safety. For years, I thought little about the issue, other than snugging the seat belt during the takeoff roll and instructing passengers how to operate the cabin door and emergency windows. And then I was in a crash.

It was a controlled crash (if there is such a thing) of a high-wing Cessna into a field of Cow Corn after total engine failure. As an occupant in the front right seat of the aircraft, I learned a lot about crash landings, including the effectiveness of shoulder restraints. But what I learned most was how vulnerable to injury cabin occupants are from unsecured items. The stuff we generally take along on every flight including flashlights, headsets, bottles of water, pens, phones, fire extinguishers—and of course, tablet computers and portable GPS units—become dangerous projectiles.

The plane was fresh out of maintenance that included interior disassembly. As a result, some accessories that should be secured in the aft baggage area ended up on the rear seat and on the floor when the shop put everything back together (inlet plugs, containers of oil, portable urinal and a small metal step ladder come to mind). It was my responsibility to secure them.

Aside from a windmilling propeller, the landing and rollout in the field was normal until the aircraft starting slicing through the tall cornstalks. That's when stuff started flying about the cabin. The aircraft ultimately ended up flipping tail over nose in the soft soil and that sent all of the loose items settling onto the other pilot and me. The aircraft had one of those large cockpit organizers that fits between the two front seats. It secures to the cabin carpeting with two strips of Velcro. It didn't stay in place when the aircraft flipped, sending it and all the gadgets stored in the compartments flying. All's well that ends well, save for a cracked tooth, some minor cuts from the shoulder belt and a spike in blood pressure.

Aside from securing loose objects in the cabin, you'll want to be mindful of where you mount portable electronics. Specifically, keeping the hardware out of the occupant flail envelope. During a crash, this is the volume of space that surrounds the flailing body. Think of the videos you've seen of crash test dummies and how the head and extremities of the dummy jerk forward and aft during impact. The flail envelope varies, depending on body size and the type of restraint system, but engineers consider the flail envelope when designing aircraft interiors. You should take a similar approach when loading your equipment in the cabin. In general, mounting a portable device to side pillars, side windows and even on the lip of the glareshield might compromise a safe flail envelope for the head. During landing, my flailing head sent the headset, ballcap and sunglasses into the windshield.

Aircraft manufacturers are improving occupant crashworthiness by considering objects that cause injury. The interior of a Cirrus is one example. While the control stick is within the flail envelope of the torso, its placement to the side of the panel could take it out of the way of a flailing head. The air vents and the ignition switch are recessed into the molded subpanel, potentially reducing injury to the torso. You might follow this lead when upgrading the avionics in your aircraft. Substitute rocker switches for blunt toggle switches and avoid placing switches where your head might impact them in a crash. It's one of many ways to delethalize the cabin.—Larry Anglisano



TURBO PENALTY REVISITED

I just received my February 2014 issue of *Aviation Consumer* and read with interest the article on turbochargers, since I've been flying my Mooney 231 converted to a 252 for the past 6500 hours and 27 years. I was surprised at the estimated turbo "surcharge" of \$25 per hour, with "most of it being for a \$2200 overhaul at 1200 hours." If you were to put aside \$25 per hour for 1200 hours (to cover a \$2200 overhaul), that would be \$30,000. Let's say the engine made it to 1500 hours. The turbo allowance would have amounted to \$37,500, which for me would more than cover both the engine and turbo overhaul.

Luckily for me, my experience has been much better. My Garrett turbo frequently lasts longer than an engine overhaul and my cost for a turbo overhaul at 1500 hours for a cost of \$2200 only comes out to a turbo tax of \$1.47 per hour. Even if you overhaul the controller and wastegate at TBO, that would be an extra \$2000 at the extreme outside, resulting in a total turbo penalty of \$4200 for 1500 hours, which is \$2.80 per hour.

Perhaps I've been really lucky, but I suspect the turbo penalty of \$25 per hour as published is probably grossly overstated. Could Mr. Durden provide me with his research that yielded the \$25 per hour figure in case I'm missing something?

Earl M. Douglass
via email

After looking at the numbers again, Durden says that \$5 per hour is a conservative number for turbo overhaul, the exhaust system inspections and possible repairs. Figure \$2200 for the overhaul and \$2000-\$4000 in exhaust system inspection, maintenance and component replacement.

FOR NON-MILLIONAIRES

I read Larry Anglisano's article on autopilot upgrades in the February

2014 issue and would like to suggest an idea for those of us who aren't millionaires.

I am a retired pilot with a 1962 Piper Cherokee. I keep the plane in good shape and fly as much as I can. At the airport where I keep it, the average value of most of the other aircraft is around \$30,000-\$40,000. While we all do our best to be safe, none of us can justify or afford to invest up to 75 percent of the plane's value in avionics upgrades.

Many of us have gotten Apple and Android tablets and portable GPS receivers, but with NexGen coming and every pilot's desire to upgrade, it's becoming almost impossible not to be behind the times.

Three years ago I decided to get my instrument rating, but first I had to upgrade my VFR panel. One shop said I needed to spend \$20,000 and another said I should spend \$12,000, at a minimum. Turns out that for \$5000, I got a heated pitot, a Navcomm with glideslope, a marker beacon receiver and a Garmin GNC300XL GPS/Comm. This is a servicable, but dated panel for light IFR.

How about doing a series of articles for those of us who can't afford the latest and greatest, but are considering upgrading to something better than what we have?

Mike Hartz
Adams County, Wisconsin

Actually, we've covered budget avionics upgrades in the past. Sounds like it's time to have another look at the market. As for autopilot upgrades, there are folks who won't fly IFR without them, so they buy them. That's why we ran the market roundup article. For entry-level aircraft like your Cherokee and for limited budgets, we recommended the single-axis S-TEC 20.

PAY-TO-PLAY ADS-B

In my Mooney Ovation, I have Garmin GTN750 and GTN650 WAAS navigators, a Garmin GDL69 XM WX satellite weather receiver, plus a

Garmin GTS800 active traffic alert system. Presently, I see no advantage in upgrading to ADS-B since FIS-B and TIS-B don't provide additional capabilities.

However, I will need to upgrade to ADS-B Out. One option is to install a Mode S transponder with 1090ES capability and interface it with one of my WAAS navigators for GPS position input.

Since I have a Bendix King KT76C transponder, I was elated to see that Honeywell is offering the KT74 plug-and-play ADS-B transponder. Unfortunately, as I dug a bit deeper into the interface, I discovered it's not exactly plug-and-play unless you only want Mode A and C capability. The ADS-B interface requires a different mounting tray, plus the KT74 needs to be wired into a WAAS GPS position source.

It's misleading to say the unit is plug-and-play. It's more like pay-to-play.

Luca F. Bencini-Tibo, ATP/CFI
Weston, Florida

Replacing the mounting tray usually isn't a lot of work, except in your Mooney (the entire radio stack needs to come out to gain access). Our advice is to compare the cost of the KT74 retrofit with that of a dedicated ADS-B transceiver, like the Garmin GDL88.

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Van's Aircraft RV-12: Factory-Built LSA

The RV-12 has Van's signature crisp handling and sporty ergonomics, plus a price that hits the sweet spot in the LSA market.

by Larry Anglisano



The way we see it, if there's an aircraft manufacturer that could have an advantage in the LSA market, it's Van's Aircraft. For decades, Van's has dominated the kit market with the proven and respected RV line. With over 8000 RV aircraft flying, homebuilt RVs have an earned reputation for excellent handling, decent ergonomics and plenty of fun factor.

Of course, before you can put your own new RV in the air, you or someone else needs to build it. But the factory-built RV-12 LSA changes that and can be purchased ready to fly.

We flew the RV-12 at the 2014 U.S. Sport Aviation Expo in Sebring, Florida, where—in an otherwise ho-hum LSA market—it attracted a healthy amount of interest.

KIT OR FLY-AWAY

Buyers aren't limited to factory-built RV-12s. The model is available in a kit and is still eligible to be licensed in the E-LSA (experimental Light Sport) category. There are some restrictions. The E-LSA category

does not permit builders to alter the design, which means no unapproved engines, propellers or avionics are permitted. Van's said the RV-12 is eligible for registration in the EAB category (experimental amateur built), but cautioned that making changes to the original design of the kit will greatly increase the complexity and build time.

On the other hand, there's no 51 percent build rule, which means anyone can assist in the build process. Van's includes everything you'll need in the complete kit (or subkits). The only thing you won't get is fluids and paint.

But for those without the time (800-1000 hours, on average) or the skill for building one, the airplane can be delivered completely finished. This includes everything from custom paint and advanced avionics to a tow bar that cleverly serves double duty as a gust lock.

GOT TRAILER?

If you do, the RV-12 was designed to be loaded on one. That's because the

wings can be removed to make the airplane easier to transport and to store at home or in tight hangars.

Wing removal and installation requires two people, one to hold the wing at the tip end (there are hand-holds molded into the tips) and another to handle the stub end. We didn't try it, but Van's says that two people can have the wings off in less than five minutes. To remove the wing, you withdraw the fuselage pins that release the wing spar and simply pull the wing off the attachment point, starting with the right wing first. Installation is accomplished in reverse order. All other connections are automatic.




If you botch the spar pin installation, there's a fail-safe ignition interlock relay and warning annunciator that monitors the spar pin position using micro switches. Unless overridden with the panel switch that's mounted next to the ignition switch, the engine won't start with incorrectly installed spar pins.

You won't need a large trailer to move the RV-12. The all-metal airplane has a 740-pound empty weight and an LSA-compliant 1320-pound gross weight. That low empty weight means the RV-12 can carry two 210-pound occupants, full fuel and 50 pounds of baggage.

On the outside, the airplane measures just shy of 20 feet from prop to tail and when the wings are attached, spans just shy of 27 feet.

The RV-12 carries 20 gallons of fuel (100LL or unleaded) for feeding the Rotax 912ULS engine. That doesn't seem like a lot, but the airplane has a range that can exceed 600 miles when you pull the Rotax back to 5000 RPM (at 7500 feet). At 5500 RPM, expect roughly 550 miles. Despite a miserly 5 GPH and

CHECKLIST

-  Despite flaperons and a full stabilator, the little RV-12 handles like heavier RVs.
-  Removable wings makes it convenient to transport and store.
-  An airplane parachute system might up the ante on safety. It's missing.

The Dynon Skyview EFIS, top photo, is plenty of avionics for the RV-12, but the carbon fiber-design overlay is too reflective. The fuses in the main electrical bus, middle, illuminate when they blow. An ignition override and warning annunciator, bottom, is a fail-safe for improper spar pin installation.



relatively comfortable seating, that's longer than we'd like to sit in the aircraft in a single leg.

PERFORMANCE

We think the newer fuel-injected Rotax 912i-series engine can step the airplane up another level, but that means an increase in price, of course. Still, the carbureted 100 HP Rotax 912ULS has proven reliability, a 2000-hour TBO and pins the aircraft with respectable performance numbers.

At the 1320-pound gross weight, the published sea-level takeoff distance is 750 feet, followed by a 900 FPM rate of climb. On our flight, we saw slightly better performance; with half tanks, two occupants and a temperature of 60 degrees, a 1000 FPM max climb wasn't a problem.

Vx or best climb angle is 60 knots, which creates a pretty steep deck angle. Once the wing flaps are up, accelerating to 75 knots (which is Vy) creates a more comfortable view over the nose, while still achieving a respectable rate of climb. We found the airplane was easy to keep coordinated in the climb, requiring only small amounts of right rudder input.

The RV-12 uses a Sensenich ground-adjustable composite propeller. Coupled with the smooth-running Rotax, it makes for a comfortable cabin environment during climb and cruise power settings. Still, the overall noise level in the cabin was higher than expected, but to be fair, we wore a passive headset.

In level cruise flight, the airplane is said to approach the top of the LSA speed limitation. Chris Theylan, a Van's test pilot, told us he regularly sees speeds in the 118-knot range. With a power setting of 5400 RPM (4.5 GPH), we saw 111 knots at 3000

feet. The published top speed is 135 MPH, or 118 knots. We also saw the handling characteristics that pilots have grown to expect from an RV, despite a design that differs from previous models in the RV line.

Initially, Van's didn't expect the lightweight, flaperon and full stabilator-configured RV-12 to fly exactly like its heavier and faster aircraft. A slower airframe is bound to have different flying qualities, so Van's simply set out to achieve a light, responsive control feel, given the LSA weight restrictions it had to work with.

As Van's founder Dick Van-Grunsven stated early in the project, "We feel that the aircraft flies much more like an RV than it does a Cessna. While this may offend some people, it will make others happy."

In our view, the RV-12 should appeal to a wide variety of pilots. High-time pilots might appreciate the aircraft's crisp and responsive handling and low-time pilots should find the aircraft to be forgiving and easy to fly. Forgiving means no bad habits and we couldn't find any.

If we had a nit, which is more of an ergonomic preference, it might be the design of the panel-mounted electric trim switch. It could be more convenient if it were mounted directly on the control stick. Still, we doubt most pilots would complain,



since it's positioned almost directly above the throttle control, making it easy to finger while a hand is on the throttle. The aircraft doesn't need a lot of trimming. We found it easy to trim accurately during level-offs and after major changes in power.

The RV-12 makes it easy for demo pilots to impress perspective buyers—especially low-time pilots that are used to heavier aircraft. An easy demonstration is to have the pilot roll the airplane into a 45-degree bank angle and then let go of the controls. There's no roll off or large changes in pitch. It's the kind of airplane that stays where you point it.

Stall speed in the clean configuration and at gross weight is 45 knots. With full flaps, it's 41 knots. In all configurations, we noted a buffet oc-



A ground-adjustable composite Sensenich propeller, top photo, is standard. A flat floor mean you don't have to step onto the seats when boarding from the front of the wings. The forward-tilting bubble canopy is easy to open and close from the inside or outside of the aircraft. The 20-gallon fuel tank sits in the midsection of the fuselage and is fueled from the right side of the aircraft, bottom photo.



CTLS has a wider 49-inch cabin. Larger pilots might find the RV-12 easier to board.

You mount the RV-12 from the inboard leading edge of the wing and once inside, step down onto a flat floor. No stepping on the seats, which are covered in basic vinyl and fabric. There's ample storage space behind the seats and we found that the small bags loaded in were easy to access from the outside of the aircraft and while seated inside.



The standard avionics package consists of the Dynon Skyview EFIS suite. It's a single-screen system with integral transponder, GPS, synthetic vision, moving map display, plus electronic engine instrumentation.

The aircraft we photographed had Garmin's discontinued SL40 communications radio, but that's recently been replaced with Garmin's updated GTR200 radio. It sits directly above the fuse panel in the center of the panel. While the fuses seem basic compared to pullable circuit breakers, the larger fuses illuminate when blown, making it easy to identify.



For avionics options, there's an available ADS-B system that displays weather and traffic on the Dynon display. It's a \$1600 option—reasonable, in our view—given the capabilities. There's also a two-axis autopilot that's controlled directly from the Skyview display. It's a \$2400 option and includes heading command and GPS tracking. The Skyview also has on-screen elec-

tronic charting, including approach plates, although the RV-12 is approved for VFR only. The instrument panel of the RV-12 is basic and well laid out, however we can do without the carbon-fiber overlay that was on the demonstrator. While it gives the panel a high-tech appearance, it created sizable amounts of glare when splashed with bright Florida sun.

The retractable sunshade, a \$250 option, fits on the top of the large bubble canopy and seems to be a gotta-have option, in our view. Still, the canopy affords awesome visibility outside of the aircraft. It's a quality fit, too. Absent were the squeaks and rattles that plague some other canopy designs. Some of this is thanks to the smooth-running Rotax, but it also reflects on the RV-12's quality fit and finish.

PRICING

The factory-built RV-12 has a base price of \$115,000. With popular options, that price can flirt with \$125,000. For instance, options include three-color premium paint package with pinstripe highlighting. It comes at an \$1800 premium. Color-matched wheel fairings are an additional \$2800. Van's offers a fully equipped version that includes the premium paint, ADS-B system, autopilot, lighting package, plus the wheel fairings for \$123,000.

One thing the RV-12 doesn't have is

a whole-airplane parachute system. For some buyers, this would make the RV-12 even more appealing than it is now, if not without a weight penalty and price increase.

Based on price, performance, fit, finish and Van's long-standing reputation for excellent product support, we think the RV-12 represents one of the better deals in the current LSA market.

curing well before the stall. At 1050 pounds, a full-flap stall is a published 37 knots. There was a slight amount of right wing drop during power-on stalls (it was a gusty day when we flew the aircraft), but recovery was quick and easy by getting the nose down and neutralizing the controls. Aerobatics and intentional spins are not approved.

CABIN AND AVIONICS

On the inside, the cabin measures 43 inches wide. For comparison, the high-wing designed Flight Design

TV RV-12 VIDEO



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Safety Refurbs: Crashworthiness

Mods that will improve the crashworthiness of your airplane or increase its overall level of safety when something goes wrong.

by Rick Durden

Goodness knows, there are a lot of ways we can spend money on improving our airplanes and plenty of folks who will promise us the moon in terms of performance or glitz or impressive panel displays. Many times the sales promotion includes a claim that the product makes the airplane safer. But which products do? New paint? Hardly. Glass panels? No proof, yet. Retrofit shoulder harness? You bet.

Deciding what hardware can make an airplane safer starts out with risk assessment. Somewhat simplified, most general aviation accidents are due to something the pilot does or does not do—the airplane usually behaves itself. Most commonly, the pilot blows a landing and runs off of the runway or tries to go around and hits something. Those runway loss of control (RLOC) events are more often injury accidents, rather than fatal—the variable is impact speed.

The killer accident for general aviation is VFR into IMC. Impact speed is often at cruise or higher

Airplanes crash—it's a fact of aviation, right. The single most effective way to make an airplane safer is to install shoulder harnesses in every seat—it's even better if they have airbags in the restraint system itself, above right. Just retrofitting and wearing shoulder harnesses decrease the risk of death by 20 percent and injury by 80 percent.

and is usually not survivable regardless of crashworthiness. With that background, the obvious steps for an owner to take are a combination of accident prevention and aircraft modification to improve crashworthiness.

Before spending a cent on the airplane, the way to reduce the risk of getting hurt in it is to buy some recurrent training, especially takeoffs and landings in crosswinds.

SURVIVAL

After doing all we can to reduce the likelihood of an accident, the next step is to increase the probability of surviving if something goes terribly wrong in spite of ourselves.

That means getting the airplane down and stopped in a way that minimizes impact loads, protecting the occupants from the impact loads experienced by the airplane, protecting the occupants from lethal missiles in the cabin and allowing them

to get out quickly if there should be a post-crash fire.

While post-crash fires are not terribly common (except in Hollywood), egress speed does matter because if there is a fire, it usually starts relatively small and takes a little time to grow. The explosions we see in movies usually are associated with high-speed impact and even then, they tend to “flash over” with the initial fire being localized, giving time for an awake occupant to get out of the airplane.

WHOLE-AIRPLANE 'CHUTE

When something goes bad in the air, the increasing availability of whole-airplane parachutes has meant lives saved. We won't haggle over how many; we'll just note that because the force of impact is a squared func-





Ballistic Recovery Systems whole-airplane parachute components, left. AmSafe airbag restraint system components laid out ready for installation, lower left.



CRASHWORTHINESS

Research since World War II has taught a lot about airframe crashworthiness—protecting an aircraft occupant during an impact sequence. Simplified, the lessons learned are: The slower the initial impact, the better. The longer in time and distance the deceleration can be spread over, the better. The more impact load that can be absorbed

by a progressively collapsing aircraft structure and not transmitted to the occupants, the better. Occupant restraint is essential—keeping the full torso restrained to the seat (via seat belt and shoulder harness) during the impact sequence vastly improves the odds of survival (the FAA says shoulder harnesses cut fatality rates by 20 percent and injury rates by a whopping 80 percent). Designing the cabin area in front of the occupants to be free of objects that can hurt the occupants as they go forward and the panel comes back in an accident improves survivability.

Knowing that information, what is available for retrofit that can improve our odds during impact?

RESTRAINTS

The obvious—and most important—solution is restraint systems. A seat belt by itself allows the occupant to jackknife, with a high risk of head

impact on the panel or the seat frame in front of you. And let's make it very clear right now, it is impossible for you to "brace" yourself to keep your head off the panel if you don't have a shoulder harness—the impact forces will either overpower you in an instant or snap your locked elbows, adding to your injuries and stunning you or rendering you unconscious, delaying your exit. Also, the jackknife over the seatbelt can give you a spinal injury that can cause paralysis.

There is not a lot of what is called flail space in a general aviation airplane. Flail space is the area in front of an occupant that the occupant's body flails around in, uncontrollably, during an impact sequence. If there's something there, the occupant is going to hit it.

AIR BAGS

The best solution to restricted flail space is a restraint system that includes a smart air bag that deploys when an impact is sensed. Close behind is a five-point belt restraint system—two lap belts, two shoulder harnesses and a crotch strap that keeps you from submarining under the belts.

For general aviation, the only purveyor of airbag restraint systems is AmSafe. Using either a two- or three-point restraint with airbag, inflator and sensor, the AmSafe system positions the occupant with the restraint and protects against impact forces with an airbag tailored for the shape of the space. The airbag is sewn and folded onto one of the belts; a gas hose runs from the bag to the inflator. A wire runs from the inflator to a sensor that tells the system when to activate. AmSafe's Lee Langston told us that the system was tested to assure that the pilot's hands do not get knocked off the yoke should there be an inadvertent inflight activation. To date there have been none.

AmSafe airbag systems are currently available for retrofit on some

tion, the slower an aircraft is going when it hits something, the better.

A night power loss, or one over rugged terrain, has a higher probability of a happy outcome if there is a whole-airplane parachute that can be deployed. VFR into IMC and loss of control events have a distressingly high fatality rate—a whole-airplane parachute improves the survival odds.

Ballistic Recovery Systems (BRS) makes retrofit systems that weigh between 28 and 85 pounds and cost from \$4600 to \$15,000 before installation. They are installed in the baggage compartment.

Currently, only a few airplanes are eligible for retrofit—some LSAs and the Cessna 172 and 182—although the list should expand. We reviewed whole-airplane parachutes in depth in the September 2013 issue of *Aviation Consumer*.

or all of the airplanes made by Air Tractor, Aviat, Cessna (singles), Cirrus, Diamond, Beechcraft, Mooney, Piper and Thrush. The list of specific airplanes, and whether the kit can be installed in rear seats or just the front, is on AmSafe's website—which also has video of testing and installation of the system. We spoke with Scott Utz, Director of Maintenance at Arapahoe Aero on Denver Centennial Airport, whose shop has installed a number of AmSafe systems. Installation times have ranged from 15 to 40 hours per seat and depend on the type of airplane and the options, such as TKS, installed. Utz told us that Pipers and Cessnas are the easiest, with Mooneys taking the longest.

Utz also pointed out that the AmSafe systems have an ongoing maintenance requirement based on time in service for the sensor at seven years (\$400) and the inflator at 10 years (\$350).

The per-seat cost of the system ranges from \$3500 to \$4500, before installation.

PASSIVE RESTRAINTS

AmSafe and Hooker Harness are the two big manufacturers of conventional restraint systems. B.A.S. sells a line of restraints manufactured by AmSafe

Hooker Harness offers a commercial line of three-, four- and five-point harnesses that fit the front seats of most general aviation airplanes, as well as an STC'd line that is targeted at the strut-braced, high-wing Cessna single-engine series and American Champion airplanes. The restraints are not inertia reel. Prices for the kits are \$275 per seat. According to Hooker's Scott McPhillips, installation takes 60-90 minutes once the headliner is removed.

AmSafe offers two-, three-, four- and five-point restraints for, as it puts it, "nearly every model of general aviation aircraft." Its website does not list prices.

B.A.S. Inc. offers a line of inertia reel four-point restraint systems manufactured by AmSafe. The kits are available for the front seats of a long list of Cessna, Beech Bonanzas, Barons and Travel Airs, Pipers and Luscombes. The harnesses can be installed in the back seats of a number of the airplanes—check with B.A.S. for availability.

AIRPLANE SELECTION

If you're in the used airplane market and want to factor crashworthiness into your selection, we suggest considering the following factors:

RESTRAINTS

We think the restraint system should be the first consideration. We do not recommend buying an airplane without shoulder harnesses installed for each seat. If they aren't already there, at least the airplane should be capable of retrofit—many aren't. We like inertia reel shoulder harnesses rather than the basic strap because pilots and passengers are more likely to wear them if they allow freedom of movement.

We much prefer integral restraints—shoulder harness and seat belt in one unit—as in a car. The idea is to make the restraint system easy to use so it will be used. Our favorite is an integral double over-the-shoulder and seat belt restraint. It is standard equipment on a few airplanes and we've seen it retrofitted on others.

FLAIL SPACE

Look at the area in front of the seats, front and rear. Is the panel padded? How about the seat backs?

We think side sticks are safer than control yokes because yokes, even when padded, are on poles that can become spears. Center control sticks aren't perfect but, in our opinion, are safer than yokes.

In many forced landings and RLOC accidents, the nose wheel digs in or the airplane hits something low on the nose, driving the occupants up and forward and their heads into the ceiling. It was recognized in the 1960s that overhead switches increase the risk of head injury in a crash, and manufacturers did what they could to put all switches on the panel.

Unfortunately, overhead switches were deemed to look cool about 20 years ago, so some manufacturers have taken to installing them again. We recommend avoiding them.

EGRESS

Bluntly stated, the more doors, the better. We like little airplanes with at least two doors, or at least a decent-sized emergency exit if there is only one door. We're not crazy about canopies or upward-opening doors, although we have not seen data that indicates occupants are trapped in those airplanes more often than in airplanes with doors. However, if they invert in an accident, getting out can mean having to kick out the plexiglass or otherwise use something to batter one's way out.

BALLISTIC RECOVERY SYSTEM

Whole-airplane parachutes are not a panacea for safety. However, we like them even though they require fairly expensive maintenance on a time schedule. Simply put, when everything has gone wrong and the pilot has exhausted the available options, a B.R.S. offers one more chance that may keep everyone alive.

NOSEWHEEL

We know that tailwheel airplanes are cooler than nosewheel; tailwheel airplanes are more expensive than a directly comparable nosewheel airplane and tailwheel pilots are more macho than nosewheel pilots.

Yet, tailwheel pilots wreck airplanes at a much higher rate than nosewheel pilots. Are they worse pilots? No. It's the design. With the center of gravity behind the main gear, tailwheel airplanes are more difficult to control on takeoff and landing—the hard fact is that they therefore have a higher accident rate than nosewheel airplanes. Plus, many of them have significantly fewer occupant protection features, so the risk of injury is higher when they do crash.

If you want to reduce your risk of an accident and of getting hurt in an accident, swallow the macho pride and buy a nosewheel airplane.



Retrofit shoulder harness in an Aeronca Champ installed as a minor modification (logbook entry only) per AC 23-17C.

Prices for the kits—which provide all the components for two seats—range from \$1250 to \$1450.

CESSNA HARD POINTS

Cessna offered shoulder harnesses as an option for all seats in all of its post-war singles and the Skymaster series. No one ordered them. Nevertheless, the shoulder harnesses can still be ordered from Cessna as a kit for any seat in those airplanes. We watched the installation in the rear seats of a Cardinal—it took less than 30 minutes. The kit provides a three-point, non-inertia reel restraint for each seat.

Scott Utz told us that his shop recently installed two kits, which took care of the four rear seats in a Cessna 210. The price was \$184 per kit. Installation took three hours per kit.

OTHER OPTIONS

In what we consider an enlightened approach to safety, the FAA considers the installation of shoulder harnesses on older airplanes a “minor modification”—only requiring a logbook entry, no STC or field approval—so long as no drilling or cutting of the structure is involved. The details are on page 101 of Advisory Circular AC

23-17C. We think that the FAA recognized that the method of attachment may not be perfect, but having shoulder harnesses is much safer than not. The AC applies to the front seats of airplanes built before July 19, 1978, and rear seats of airplanes built before December 12, 1986.

It means that for older airplanes, especially high-wing Pipers, a good restraint system can be installed with a little thoughtful work by a mechanic. We’ve seen it done on Piper Cubs, Super Cubs and Aeronca Champs—a good thing, in our opinion, given their proclivity for RLOC accidents and the presence of the fuel tank right behind the engine on the Cub

and Champ.

We spoke to Derek DeRuiter, owner of Northwoods Aviation in Cadillac, Michigan. His shop does a lot of work on back-country airplanes and he has installed various types of shoulder harnesses on tail-wheel Pipers and Cessnas. He told us that there were a number of ways to install shoulder harnesses into the braces above and behind either seat in a Cub or Super Cub without drilling or cutting, easily allowing compliance with AC 23-17C.

PADDED DASH

The manufacturers started padding the top of instrument panels in the 1960s. While that may not seem like a big deal, it can help avoid a head injury. Currently, Superior Panel Technology offers a \$229 kit that provides the materials to custom make a padded glare shield for any airplane. Installation time varies by airplane type.

CARGO NET

In Larry Anglisano’s column on page 2, he vividly brings to light how loose stuff in the cabin becomes missiles as an airplane slams around violently in an impact and stopping

sequence. I’ve looked at airline and general aviation accidents where occupants were seriously injured or died because they got hit by a flying piece of luggage, even though the impact forces in the accident itself were not high enough to cause much injury otherwise.

Our recommendation is to use the baggage net that came with the airplane. If it’s not there, order one from a parts supply house and use it. Also, look around the cabin and see what sort of stuff is there—keeping in mind that impact sequences can involve serious G-loads from any direction. This is an area of risk that is cheap to remediate—stow the loose gear and secure the portable antennas and handheld devices so they won’t fly around.

SLOW DOWN

Force as a squared function is a grim law of physics—doubling the speed quadruples the impact. That means that when you have to put the airplane down in circumstances you’d rather avoid, being able to slow down a few more knots on touchdown can be vitally important. (Just don’t stall the airplane prior to touchdown; the loss of control and

continued on page 32

CONTACTS

Ballistic Recovery Systems
651-457-7491
www.brsparachutes.com

AmSafe
830-537-5601
www.amsafe.com

Hooker Harness
815-233-5478
www.hookerharness.com

B.A.S.
888-255-6566
www.basinc-aeromod.com

Superior Panel Technology
562-776-9494
www.sptpanel.com



Renter's Insurance: Know The Exclusions

There's affordable coverage for the majority of aircraft you are likely to rent or borrow. Look for a policy with a no-fault deductible provision.

by Jon Doolittle

According to GAMA statistics, there are 611,000 active pilots in the United States and only 223,000 registered general aviation aircraft. Even allowing for air taxi airplanes, clubs and partnerships, this means that lots of us are flying airplanes that we don't own. Some of us rent from local flight schools, some borrow from friends.

Few flight schools can afford to carry insurance that gives the student or renter pilots much, if any, protection. And while permissive users of privately owned airplanes are usually automatically included under the aircraft liability coverage, insurers will frequently subrogate to recover the cost of physical damage.

With new singles tipping the scales at over \$600,000, this is an increasingly risky proposition. Even

an old beater can cost a great deal to repair. Airplanes are expensive, delicate things that can be ruinously expensive to repair (even more so for the people riding with you in them). The aviation insurance industry is

If you rent aircraft, ask the FBO how much insurance it has and if it covers you.

ready with a solution: Personal non-owned aircraft liability insurance, or renter's insurance.

SUE-ME COVERAGE

Renter's insurance typically contains two parts: The first protects the renter from lawsuits brought by passengers or others who claim that they suffered bodily injury, or people who claim that the renter negligently

damaged their property while using the rented aircraft. The second part, which is optional, protects the renter from lawsuits arising from damage that he or she negligently caused to the aircraft.

Both parts of renter's insurance is "sue me" insurance, because coverage is based on the renter being at fault, or at least being accused of it. If the renter is not at least blamed for negligently causing damage or injury, there probably is not any coverage. But if there is a claim of negligence, the insurer will provide attorneys to defend the renter. And if the owner of the aircraft makes it stick, the renter's insurer will pay.

Personal non-owned aircraft coverage is tailored to the student pilot, the renter pilot and almost anyone else borrowing or using an airplane for a non-commercial purpose. Most of the companies also offer additional coverage for individual CFI's while they are providing flight instruction.

Keep in mind that a renter's policy will usually not cover the owner(s) of the airplane, an airplane that is leased for more than 30 consecutive days, any commercial operations or any type of aircraft not listed in the policy.

In its most basic form, a non-owned policy will cover use of a non-pressurized, single-engine fixed-wing landplane with no more than seven seats and no more than 450 HP.

Coverage is available from one or more companies for multi-engine airplanes, floatplanes, experimental aircraft and even piston helicopters. Available non-owned bodily injury and property damage liability limits range from \$250,000 per accident to \$1,000,000 per accident, limited to \$100,000 per person or per passenger. Aircraft damage coverage ranges from \$1000 to

\$200,000. We wish that higher liability limits were available, especially for bodily injury, as it generally is for owned aircraft.

MAJOR PLAYERS

Providers of non-owned insurance include AVEMCO, AIG, QBE Aviation and Starr Aviation. Global Aerospace also writes a non-owned program for EAA members. Each

TYPICAL RENTER'S INSURANCE PREMIUMS	
BODILY INJURY AND PROPERTY DAMAGE LIABILITY	
\$250,000 PER OCCURENCE, \$25,000 PER PASSENGER	\$76
\$500,000 PER OCCURENCE, \$50,000 PER PASSENGER	\$96
\$1,000,000 PER OCCURENCE, \$100,000 PER PASSENGER.	\$190
\$1 MILLION PER OCCURENCE, \$200,000 PER PASSENGER	\$499
AIRCRAFT DAMAGE LIABILITY COVERAGE (ADL)	
\$1000 DAMAGE LIMIT	\$71
\$5000 DAMAGE LIMIT	\$86
\$10,000 DAMAGE LIMIT	\$152
\$30,000 DAMAGE LIMIT	\$285
\$50,000 DAMAGE LIMIT	\$475
\$75,000 DAMAGE LIMIT	\$665
\$200,000 DAMAGE LIMIT	\$1710
<i>Based on single-engine, non-pressurized fixed wing with up to seven seats, maximum 450 HP. Loss experience may change rates and availability.</i>	

provider has a different policy form and each tries to offer something unique.

Starr Aviation has a CFI program tailored to members of the Society for Aviation and Flight Education (SAFE). AVEMCO provides enhanced coverage to CFIs who are members of the National Association of Flight Instructors (NAFI). AIG Aviation offers coverage on behalf of AOPA members and along with AVEMCO, is one of the two original providers of this coverage.

AIG and Starr Aviation both provide coverage for piston helicopters. Starr created a mobile app that allows policyholders to view their policies, find claims contact information, an accident checklist and provide proof of insurance on the fly.

AVEMCO can be accessed directly by individual pilots. The other companies are reached through brokers.

WHAT TO AVOID

Remember that if you want protection for damage to the airplane, you need to buy both coverages to get it. Liability for bodily injury and property damage by itself will not cover damage to the airplane. Read the policy form carefully. Most of them are fairly short and well-worded.

While all are similar, each of them has specific coverage territories, definitions of cost-sharing and types of aircraft that are included. Words in quotes or boldface have specific

meaning that can be found in the definitions section of the contract.

Never use non-owned liability insurance to cover an airplane that does not have primary hull and liability coverage on it. If it wasn't your fault, it probably isn't covered by non-owned. If you are using an airplane that you don't own, and you are fortunate enough to have that rare accident that was not your fault, your renter's policy probably won't cover it.

Make certain that you know what types of aircraft are covered on your policy. Discuss with your insurance provider what kind of flying you do and in what kind of aircraft.

Some policies exclude experimental aircraft, or kit-built aircraft during a fly-off period. Some exclude floatplanes. Many exclude twin-engine airplanes unless you specifically request it. Most exclude helicopters, unless you specifically purchase extra coverage. If you are being paid to be in an airplane and you are not a CFI, you need the kind of non-owned coverage that flight schools and commercial flying services carry.

If you rent, ask the FBO how much insurance they have and whether any of it protects you. You should understand the terms of the rental agreement and whether the FBO requires you to be responsible for the deductible or the full value of the airplane. In some cases, you

might be covered by the school, but you need to understand how much coverage they offer.

"We do not require renters insurance. It's included in our pricing. We own our entire fleet so our prices aren't dictated by leasers, but by actual operating costs," said Kevan Ross, the chief instructor at Connecticut Flight Academy in Hartford, Connecticut. CFA's fleet has a clean accident and incident record. We wonder if that policy might change if that record were to change.

Still, look for a renter's policy that carries a no-fault deductible provision. This provision allows your policy to pay the flight school's deductible even if the damage to its airplane was not your fault. CFA's Ross told us his school would pick up the claim deductible. That's an exception, rather than the rule.

If you own a share of an airplane as a partner, or if you are in an equity-based flying club, ask if there is a non-owned product that will help you to increase your coverage. Although owners are excluded in most of these policies in capital letters, some carriers will cover partners and club members if their ownership percentage is 20 percent or less.

In addition to what is offered in off-the-shelf products, some underwriters will provide higher limits of liability, or specialty coverage. In general, we feel that the market for non-owned liability insurance is fairly well served and most premiums are palatable.

For an arguably good price, you can get coverage for the vast majority of types of planes and helicopters that you are likely to rent or borrow. Our main reservation is that current limits of bodily injury coverage available in these policies are lower than what many pilots are comfortable with.

CHECKLIST



The market for non-owned liability insurance is well served.



You can get non-owned insurance for helicopters, twins and floatplanes.



If the renter or non-owner isn't at fault, there likely isn't any coverage.

Gap Seal Mods: Improved Handling

Initially promoted as a speed mod, aileron and flap gap seals should give a small improvement in cruise, but the major benefit is in roll rate and handling..

by Rick Durden

Pilots have been looking for ways to make their airplanes faster and more efficient since there has been airplane ownership. One of the long-targeted spots for aerodynamic clean up has been the gap between the trailing edge of the wing and the ailerons and flaps.

The idea was that reducing the flow of high pressure air from under the wing, through the gap, to the low pressure area above the wing, should increase overall lift and allow the wing to operate at a slightly lower angle of attack, making it faster. It proved to be generally true and gap seals became a stalwart part of virtually all speed mods.

Aileron gap seals proved to have an unexpected benefit, discovered as early as 1937—a N.A.C.A. (predecessor to NASA) Technical Note that year reported on testing—sealing the gap improved rate of roll.

We looked at who is offering gap seals for what airplanes, what claims are being made and whether gap seals do increase performance. We came to a few conclusions: that the big benefit to gap seals is not widely recognized—improved handling in roll and rate of roll; the mod shops make speed claims in MPH because it sounds better than knots; there will be some speed increase, but don't count on more than one or two percent—with potentially some increase in rate of climb and flap gap seals do not adversely affect stall speeds.

Gap seals are not something that a

Laminar Flow gap seals are riveted to the rear spar.

developer can just put on the market. They require Supplemental Type Certification (STC) testing. However, the FAA testing is aimed at assuring that the airplane's handling as well as stability and control are not degraded, not measuring performance.

LASAR AERO STYLING

Lasar offers flap and aileron gap seals for M20B-M20G (flap gap) and M20B-M20K (aileron gap) Mooneys. The material is aluminum. The seals are installed with pop rivets. The flap gap seal is essentially a model of the changes Mooney made in 1977 with the Model 201. According to Lasar's Paul Loewen, its 2.5 MPH speed increase information published is from Mooney. Customers have reported

CHECKLIST



Aileron gap seals improve roll rate and handling in roll.



Flap gap seals do not increase stall speeds with flaps deflected.



Gap seals will give a modest speed increase; don't expect too much.

an increased rate of climb in before and after flights. There is no change in full-flap stall speed, according to Loewen.

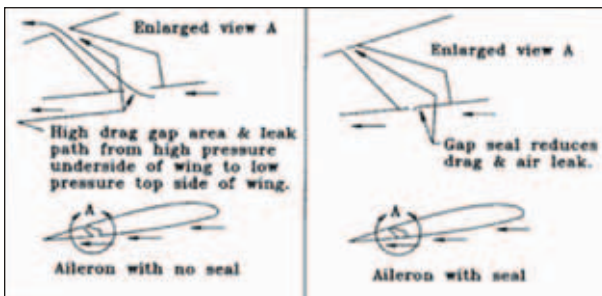
Price for the flap gap seal is \$325. Lasar estimates installation time at 12 hours.

The aileron gap seal uses Mylar chafing tape to protect the skin of the aileron and prevent an increase in control forces due to friction. Lasar only claims a 1 MPH speed increase. Price is \$180—estimated installation time is two hours.

LOPRESTI

Founded by Roy LoPresti, his eponymous company has been making speed mods for decades. We spoke with company president, Curt LoPresti who told us that they concentrated on Pipers when it came to gap seals. They designed, tested





inboard of the ailerons. Consequently, stopping the flow of high-pressure air under the wing, through the gap has more effect inboard. In testing, the expectation matched the reality—the speed increase from aileron gap seals was

almost negligible.

We were quoted a price of \$1149 for flap gap seals for the PA-28 and -44, with an installation time of three to five hours.

HORTON

It seems Horton has been making STOL kits and speed mods for Cessnas since Clyde built his second airplane. It offers aileron and flap gap seals for a wide variety of Cessna singles, all strut-braced, through the 1986 model year.

Aileron gap seals are the buyer's choice of aluminum or fiberglass. The seal is attached to the rear spar of the wing. The Horton representative we spoke with told us that the company's experience was that the aileron gap seal gave at least a 2 MPH increase in cruise speed, but that the big improvement was in roll rate and low-speed handling, particularly on landing.

The flap gap seals are aluminum with silicone adhesive and are secured using blind rivets to the rear spar, flap support brackets and flap well bulkheads. The Horton representative did not claim any increase

D'Shannon Bonanza aileron and flap gap seals on a Bonanza, left. Gap seals, the theory, lower.

in cruise speed. He noted that because Cessna used Fowler flaps that moved aft and down during extension, that there had been concern about an increase in stall speed with flap gap seals. He said that testing by the company and the FAA for the STC revealed no change in stall speeds.

Price is a total of \$349 for both kits. Installation is estimated at eight to 12 hours.

KNOTS2U

Growing from the work of Jim Bradshaw, its late founder, in making the Piper Twin Comanche some 20 MPH faster, Knots2U has expanded into speed mods for a wide variety of singles and twins. It provides various gap seal kits for airplanes in the Piper, Beech and Cessna lines. The seals are aluminum with an anti-chafe strip made of ultra-high-molecular-weight (UHMW) plastic. According to Knots2U's John Bailey, the strip should last 10-15 years and is easy to reinstall.

For the Piper line, aileron gap seals are available for almost all airplanes in the PA-24, -28, -30, -31, -32, -34 and -39 series lines. The seal is aluminum and is installed inside the aileron well with screws. It is easily removable for inspection and maintenance. Prices range from \$235 to \$381.60—for the Twin Comanche the price is \$658 for a combined flap and aileron gap seal kit; Bailey told us that installation takes about five hours.

The flap gap seal designed by Knots2U is also aluminum and installs inside the flap well. Prices range from \$229 to \$254; installation is estimated to take four hours. Bailey told us that their testing showed a reduction in stall speed and an increase in rate of climb of between 100 and 125 FPM.

According to Bailey, the performance improvement with flap, aileron and stabilator gap seal kits installed is 4 to 5 MPH.

For Beech Bonanzas and Debonairs, Knots2U has a combined aileron and flap gap kit priced at

and received approval for aileron and flap gap seals, but eventually decided to only market the flap gap seals, which it makes for the PA-24, -28, -32, -34 and -44. The seals are composite with a Teflon strip bonded to the composite during fabrication, making the seal effectively a lifetime unit.

The seal is attached to the wing skin forward of the spar with blind fasteners. The seal itself has a small spring force upwards, so it stays tightly against the flap in service.

The claimed speed benefit varies among the airplane types, however, LoPresti said the improvement tended to be about 3 MPH with some boost in rate of climb.

Expressing a concern about the effect of the seal interfering with the airflow over the flap when it is deployed, LoPresti said testing revealed no change in flaps-deployed stall speeds.

In our discussion, LoPresti talked about the lift distribution on a wing and the expected speed benefit of gap seals. He said to visualize an airplane head on—the lift distribution is such that the most lift is generated

Knots2U gap seals are screwed to the inside of the aileron cove.

\$554. The seals are aluminum with the UHMW anti-chafe strip. They are installed inside the aileron and flap wells—installation is estimated at 11 hours total.

According to Bailey, the flap gap seal does not affect stall speed; however, the effect of the aileron gap seal is to reduce stall speed slightly. The aileron gap seals increase roll rate and response at all speeds. Cruise speed is increased by about three knots and rate of climb between 50 and 75 FPM.

Knots2U does not offer aileron gap seals for Cessnas. It does sell flap gap seals, which increase cruise speed by 3 to 4 MPH and rate of climb by about 75 FPM, according to Bailey.

The flap gap seals are aluminum and are riveted into the flap well skin. The flap gap seal kits are available for most of the Cessna strut-braced single engine line—price for the 150/152 is \$495, for all others it is \$515.

LAMINAR FLOW SYSTEMS

Laminar Flow Systems (LFS) has been making speed mods for much of the Piper Cherokee line since 1983 and is credited with being able to make the basic Cherokee 140 as fast as the Archer without touching the engine. As part of its kits, LFS makes aileron and flap gap seals for most of the PA-28, -32 and -34 series airplanes. It does not market aileron gap seals for Friese aileron-equipped airplanes.

The flap gap seals are aluminum. They are riveted to the rear spar of the wing. Price for the kit is \$195—installation takes an hour and a half, according to LFS's Darren Tilman, who designed and builds the seals.

Tilman told us that an owner can expect a 2-3 MPH cruise speed increase with a bump of about 20 FPM in rate of climb.

The LFS aileron gap seal is aluminum with high-density polyethylene tape applied to reduce friction and to prevent ice from attaching to the seal. It is attached to the skin with blind rivets. According to Tilman, the attach point is an inch forward of other aileron gap seals, so the seal



is subjected to less bending moment with aileron deflection, meaning less friction and wear. He said that the FAA STC testing required 20,000 cycles of full aileron deflection—he ran 70,000 cycles on the test unit without cracking of the seal.

The aileron gap seal kit is \$279, installation takes, according to Tilman, 1.5 hours. Speed gain depends on the airplane, but is usually in the 2-3 MPH range. More significantly, his testing shows that at 100 MPH IAS in a Cherokee 140, roll rate increases by 80 percent.

Both the flap and aileron gap seals are warranted for the life of the airplane. Tilman said that in 30 years, he has only had to replace three segments of flap seal.

D'SHANNON

New management has the largest STC holder for Bonanzas, Debonairs and Barons actively developing new mods, while sticking with and improving performance upgrades it has been selling for over 50 years. Owner Scott Erickson told us that the company is being very careful with its promises and that he claims no top-end speed increases for the Baron, Bonanza or Debonair through the use of gap seals.

Erickson noted that customers often purchase D'Shannon's gap seal

kit—aileron and flap gap seals—along with a VG kit. For straight tail airplanes, the installation of VGs on the vertical stabilizer knocks one to three knots off the cruise speed. According to Erickson, an accompanying gap seal installation means no diminution of cruise speed.

The D'Shannon aileron and flap gap seals are aluminum, have been through Alodine treatment and are ready for painting. Teflon tape is used to prevent chafing on the control surfaces. The kit also includes a seal between the inboard end of each flap and the fuselage. The gap seals are riveted to the wing skins.

Price for the full kits are \$580 for a Bonanza or Debonair and \$950 for a Baron. Installation is estimated at 12-15 hours. D'Shannon offers a lifetime warranty on the parts.

CONCLUSION

We think gap seals will result in some modest speed increase—on the order of one to two percent, which could get lost in measurement error.

The major benefit of aileron gap seals, it appears to us, is in handling and control authority in roll. We did not see any indication of increased stall speeds with flap gap seal—and with aileron gap seals, the stall speed may go down slightly.

Portable ICS: DRE and Avcomm Win

But at under \$100 for a two-place version, Aircraft Spruce's Skycom 200E is the runaway best value for a basic intercom.

by Paul Bertorelli

The most unsung aviation invention of the past 40 years isn't diesel engines or glass panels, but the lowly headset, without which most of us would be deafer than we already



are. And if headsets are to do their stuff, they need to be plugged into effective intercom systems (ICS), a product category that improves with each new iteration.

Panel-mount ICS dominates the market, but there's still a place for small, battery-operated portables in legacy airplanes with no electrical systems or perhaps in modest aircraft whose owners don't want to invest in panel-mount gear. And who can blame them?

There are plenty of contenders in portable ICS, both in two- and four-place designs. Of late, features in these products rival those found in more expensive panel units and we find that performance of these intercoms is excellent across the board.

DESIGN BRIEF

Chances are, a portable ICS will be used in a small cockpit so overall size is a critical consideration. So is wiring design. In the non-electrical Cub we tested these intercoms in, there's virtually zero space to accommodate a portable and the necessary wiring—headsets, radio leads and push-to-talk switch—just begs to



tangle around the stick, the rudder pedals and seatbelts. The simpler the intercom's wiring scheme, the better.

In that vein, two of these products have something we haven't seen

before: Onboard PTT switches that eliminate the need for a remote PTT and the wiring that goes with it. This can be a real plus, in our view.

In some airplanes, battery power will be sufficient, but in others, using ship's power may be desirable. But again, that's another wire to deal with and another tradeoff.

One caveat about performance: The manufacturers warn that intercom performance is strongly influenced by headset quality, especially mics. They're right. We found so much variability in squelch response and distortion levels among headsets that we're reluctant to say one ICS performs measurably better than another.

As far as market breadth, we've selected representative models from major manufacturers, but we didn't test all the available products. For instance, Pilot Communications USA, which makes the Skycom 200E for Aircraft Spruce, has additional two- and four-place models.

AIRCRAFT SPRUCE SKYCOM

As noted, this ICS is made by Pilot and branded by Aircraft Spruce. At \$89.95 for the two-place version, it's by far the least expensive ICS we could find. For \$118.95, the Skycom can be fitted with an expansion module for the backseaters.

Performance is on par with the more expensive intercoms, but we noticed that the 200E may be a little less tolerant of variability in headset mics. It holds squelch well enough, but takes some finessing to get it right.

One thing we didn't like was the 200E's radio interface. It has a single jack that splits the two mic circuits and requires a remote PTT, leading to a wire routing challenge and the inevitable tangles. All of the other products have dedicated jacks into the radio and two have onboard PTTs.

Pros: Smallest size, by far. For the money, the 200E is the slam-dunk best value and delivers adequate performance for under \$100.

FlightTech ITC-401, top left, has an onboard PTT at the top of the chassis. The DRE 205e, below, can be panel mounted.

PORTABLE ICS COMPARED

MODEL	SIZE (INCHES)	WEIGHT	POWER	PTT	INPUTS	OUTPUT	PILOT ISOLATE?	PRICE*
AIRCRAFT SPRUCE SKYCOM 200E	2.8 X 2.2 X 1.2	6 OZ.	ONE 9-VOLT	EXTERNAL ONLY	NONE	NONE	NO	\$89.95
AVCOM AC-2EX	5 X 2.7 X 1.75	15.6 OZ.	ONE 9-VOLT, EXTERNAL POWER	EXTERNAL, ONBOARD	MUSIC	RECORDER/AUDIO	YES	\$228
HEADSETS DRE-205E	4.5 X 2.5 X 2.5	1 LB 2 OZ	TWO 9-VOLT, EXTERNAL POWER	EXTERNAL ONLY	MUSIC, PHONE	RECORDER/AUDIO	YES	\$349
FLIGHTTECH ITC-401-TC	4 X 2.4 X 1.5	9.1 OZ	ONE 9-VOLT	EXTERNAL, ONBOARD	NONE	NONE	NO	\$169.95
PSENGINEERING AEROCOMM III	4.3 X 3.1 X 1.5	12 OZ	ONE 9-VOLT, EXTERNAL POWER	EXTERNAL ONLY	MUSIC	NONE	YES	\$295

*PRICES ARE AIRCRAFT SPRUCE RETAIL, EXCEPT FOR PSENGINEERING, WHICH IS TYPICAL DISCOUNTED PRICE

Cons: The radio interface is lacking; it could benefit from an on-board PTT.

AVCOMM AC-2EX

Along with the DRE 205e, this ICS ranks as heavy duty in this group of five. At \$228, it delivers exceptional features, including dedicated PTT jacks for both stations, plus an on-board PTT button, a music input jack and an ICS system audio output for a recorder or camera.

The radio interface is a single cable with two jacks for the radio's mic and audio. Since no remote PTT is needed, the installation is quick and clean, a real plus if the intercom is used only occasionally and will be removed between flights.

Audio performance and noise rejection appears to be excellent and the size, while larger than the 200E, isn't too large for a small cockpit.

Pros: Definitely the high-value leader for a full-featured portable ICS. At \$228, it has about every capability you could want with crisp audio and good squelch.

Cons: The battery, a single 9 volt, is a tight fit and a bit tough to get into its compartment.

DRE-205E

DRE used to be a player in the budget headset market and had a reputation for good quality at moderate prices. Headsets, Inc. has now

taken over that line, including this upscale portable intercom that's positioned in the same market space as the Avcomm AC-2EX. It's slightly smaller than the Avcomm unit, but deeper and a bit heavier.

The 205e has separate jacks for the two stations, including a jack for a remote PTT. But it has no onboard PTT, which would be a nice option. On the other hand, it has a stuck mic indicator and a music mute function, plus

a low battery indicator. In addition to the music input and recorder output, the 205e has cellphone input. Some owners will want that function for ground phone calls. Unique among these products, the 205e is also shipped with brackets for panel mounting. Its wiring and input jack design make this a practical option.

The 205e has booming audio out-

The Avcomm AC-2EX, right, has the best overall featureset while the Spruce Skycom 200E earns top marks for best value.





PSEngineering's aerocomm III, above, has an automatic squelch feature called IntelliVox. It also has automatic muting for the external music source.

put and is capable of exceeding the threshold of pain. This may give it some advantage in squelching noise because we noticed that in the Cub's stupid-loud cockpit, the intercom never seemed to distort noticeably at the higher squelch settings.

At \$349, the 205e is the most expensive of this group, but also the most feature packed if you consider the panel mount option. If you want the phone input, for instance, it's probably worth the additional \$120.

Pros: Impressive overall feature-set that's easy to use. The ICS has two 9-volt batteries that slide into easy-to-install drawers, the best such design we've seen. Its durable case and controls and the panel-mount option are a nice plus.

Cons: We really miss the onboard PTT. Saving the extra wiring is always a good idea.

FLIGHTTECH ITC-401-TC

Next to the Spruce 200E, this was the smallest and lightest of the ICSs we tried. At \$169.95, it's also a good value, given its performance. On

our first test flight with it, we noticed its audio seemed crisper on the ground. It did well enough in the air, but in the noisy Cub, we had to crank the squelch up to near the limit to get it to hold, which introduced noticeable distortion, but without rendering the audio unreadable. Caveat: Swapping headsets may have yielded a different result, so we're not attaching too much weight to this observation. Different headsets could change it.

The ITC-401-TC uses the same radio interface as all but the 200E, with a pair of jacks for the radio mic and audio. However, these are attached to separate cables, which increases the tangle factor. Tie-wrapping them together would address that.

Pros: Good basic intercom at a fair price. Onboard PTT is a plus. It's the only intercom with an active-on light.

Cons: Nothing worth mentioning.

PSENGINEERING AEROCOMM III

Well known for its high-performance panel-mount audio systems, PSEngineering has leveraged some of that technology into this portable ICS in the form of what it calls IntelliVox—essentially automatic squelch. Where the other intercoms have both volume and squelch controls, the aerocomm III has only volume.

This works well, to a point. With the Cub's door open and slipstream and engine noise slamming the headset mics, the aerocomm tended to break squelch periodically, but not continuously.

While this isn't perfect performance, we didn't find it off putting. The tradeoff is that the aerocomm's audio is never distorted, while the other intercoms tend to distort slightly at squelch settings high enough to resist breaking. Moreover, the aerocomm is a better performer in quieter cockpits because you don't have to fool with squelch.

Sizewise, the aerocomm is the widest of the group, at 3 inches, so it won't fit in same tight quarters that the others will. It has a pilot-isolate feature, but no onboard PTT. It can be expanded to four stations.

At \$295, the aerocomm is toward the top of the price tier.

Pros: IntelliVox works well in a moderately noisy cockpit but struggles in high noise. It seems to be the most distortion free of any of the ICSs we tried.

Cons: At a price higher than the AC-2EX, the aerocomm doesn't have as many features.

RECOMMENDATIONS

Frankly, you won't go wrong with any of these ICS products, in our estimation. They're all credible performers. For a minimal intercom, the Spruce Skycom 200E is unbeatable for the price. Its performance is good if not exceptional and its small size means it'll fit anywhere. Just know that the interface with a portable radio or even a panel mount isn't the best.

Our top choice for a full-feature portable ICS is the Avcomm AC-2EX, which appears well built and is loaded with features that work well in the minimal cockpit. At \$228, it's an excellent value. If panel mounting is a consideration or you want a phone interface, the DRE 205e is the only choice and is well supported by Headsets, Inc.

CONTACTS

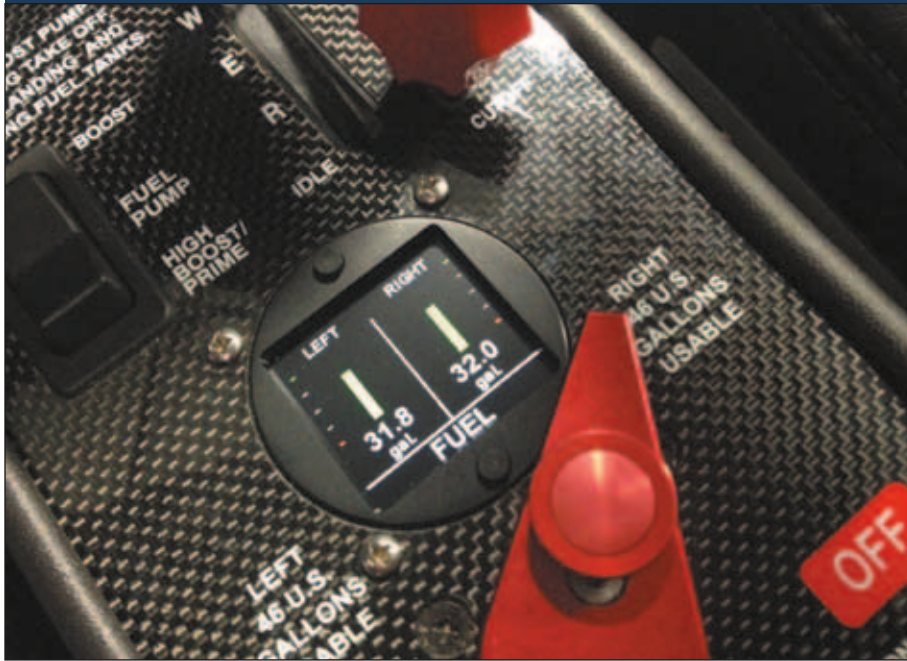
Aircraft Spruce and Specialty
877-477-7823
www.aircraftspruce.com

Avcomm Communications Systems
800-845-7541
www.avcomm.com

Headsets, Inc.
800-876-3374
www.headsetsinc.com

FlightTech Intercoms
630-324-8199
www.flighttech.com

PSEngineering
800-427-2376
www.ps-engineering.com



The CiES digital fuel level senders can connect to the Aerospace Logic control head, left, which drops into the existing analog fuel gauge cutout in the center console of the Cirrus.

Fuel Gauge For Cirrus: Better Than Stock

It's not cheap or perfect, but the CiES digital fuel sender retrofit for the SR20 and SR22 delivers on the claim of improved accuracy.

by Larry Anglisano

The preliminary NTSB report for a parachute-deployed Cirrus SR22 wreck says, in part, "Initial examination of the airplane by an FAA inspector did not reveal any visible fuel in the airplane's fuel tanks, nor were there any indications of a fuel spill at the accident site. After the airplane was recovered, approximately 26 ounces of fuel was drained from the fuel system."

We have to wonder if the pilot flying this Cirrus was relying on the potentially inaccurate fuel gauge that some earlier-gen Cirrus pilots are familiar with. If he was, it's the kind of accident that Oregon-based CiES, Incorporated is trying to address with its FAA-approved digital fuel level sender retrofit, which also includes an FAA-approved primary replacement fuel quantity gauge.

We retrofitted the setup in our

first-generation SR22 test bed, and while it's not perfectly accurate—or inexpensive—it outperforms the OEM arrangement.

MAGNETIC FLOAT

On earlier Cirrus models, fuel quantity is measured with typical analog float-type quantity sensors installed in each fuel tank (there's a main and collector tank in each wing, with a single fuel sender for each inboard and outboard tank).




The measured fuel quantity for the left and right tank is read on the mechanical fuel quantity gauge that's mounted on the center console, above the fuel selector. In later models equipped with the Perspective G1000 avionics suite, the fuel quantity information is first sent to the engine/airframe unit (EAU), processed and transmitted to the

onscreen electronic fuel quantity display (and CAS window). But this digital quantity display doesn't improve accuracy, since it's the older analog fuel senders that are the culprit for fluctuating fuel measurement. Current Cirrus models (from 2012 models on) incorporate the CiES digital senders as standard equipment. The retrofit kit is available for all SR20 and SR22 aircraft not so equipped.

To appreciate the accuracy that a digital fuel sender can provide is to understand the shortcomings of the average mechanical float-style sender, which in many applications were born from typical automotive senders. Automotive resistance-type ceramic sensors that are reconfigured for use in aircraft often fall short in performance due to the large quantity of fuel that's stored in an aircraft fuel tank. A signature trait is the fluctuation in displayed fuel quantity as the sender's resistance wiper moves.

You've likely heard the tongue-in-cheek adage that aircraft fuel gauges are accurate when the tank is out of fuel. That's true, as many fuel gauges are calibrated for the empty and full position. The other problem is the fuel itself. Unlike automotive applications, the same fuel often remains in the tank for long periods of time, allowing impurities to build up on the measuring resistors. Over time, this can have a negative effect on the

CHECKLIST

-  We confirmed the CiES claim of two-gallon or better measuring accuracy.
-  Aerospace Logic fuel gauge has a useful fuel tank balance feature.
-  Considering the investment, we hoped for tighter accuracy.



Cirrus models have two fuel tanks in each wing—main and collector, top photo. Access is gained from the underside of the wing. The original analog float-type senders are replaced with digital senders, middle. The FL202G trend graph page keeps track of fuel used since the last power cycle, bottom.



or traces of resistance inside of the fuel tank. Instead, the CiES sensor utilizes a magnetic pickoff located on the float arm, which is detected by the non-contact sensor on the outside of the tank.

The digital fuel sensor has more than one advantage. It converts the changes in fuel quantity (which the internal sensor sees as a change in voltage or resistance) to a digital signal. Computed fuel level is transmitted through a simple digital databus, cleanly transferring multiple pieces of fuel level data to a multifunction display. CiES

uses a similar digital sensor to measure TKS deicing fluid levels.

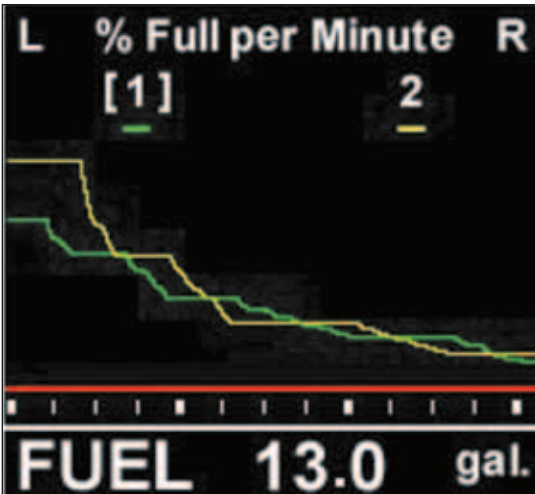
SMART DISPLAY

The CiES senders work with the FL202G digital quantity gauge that's made by Aerospace Logic. The sensor also communicates with the Cirrus Perspective onscreen fuel display.

STC-approved as a primary gauge, the FL202G has a 65,535-color LCD display and mounts in the same cutout as the original fuel quantity gauge. It connects with the fuel sensor wiring through a DB25 interface connector.

We found the display to be readable from a wide angle. This is important because in the Cirrus, the control head is mounted on the center console—an awkward location.

While there's a dedicated remote



resistors' value and overall accuracy.

The CiES digital sensor is magnetoresistive or specifically, AMR (for anisotropic magnetoresistive). According to CiES, this magnetic fuel sensor is proven to work well in a variety of temperatures and conditions that aircraft fuel tanks are exposed to, including the extreme sloshing of fuel within the tank (especially in turbulence). It's also compatible with alternative fuels, reports CiES.

The AMR sensor operates on the scientific theory that the electrical resistance of ferromagnetic alloys are influenced by external magnetic fields. Simply put, the fuel sensor always points to the measuring float (like a compass that always points north, no matter how you move). The design of the sensor has a safety advantage since there are no wires

dimmer potentiometer for adjusting the display backlighting, we would like to have the display connected to the main instrument dimming circuit. For now, it's not compatible with the Cirrus dimming bus, so it requires a dedicated control.

There are two buttons on the bezel. The top button advances between display screens, selects an action from a menu and is used for programming. The bottom button is used to select the measured quantity in the left or right fuel tank.

The FL202G display comes pre-programmed with specific Cirrus aircraft data, while the values for usable fuel are set during instrument calibration. For instance, the fuel quantity red line on the SR22 is less than 0.1 gallons, yellow line is between 0.1 and 14 gallons and the green line is for all quantities greater than 14 gallons. The default screen displays the quantity level for each tank in a color vertical bar format, plus a numerical value below the bar.

We found the quantity display intuitive to interpret at a glance. There's also a fuel imbalance warning, which is set during programming. A flashing yellow bar on either tank designation indicates a fuel imbalance condition. The flashing tank indication will be that of the tank with the most fuel. In the SR22, a 10-gallon imbalance will trigger the alert. We think this serves as a useful reminder to switch tanks. On the other hand, missing is an audio output that would eliminate having to keep an eye on the gauge. While this would complicate the install, it would be nice to have the option.

While we like the gauges' trend-graph function, which provides a scrolling line graph of the total fuel used from each tank (since the last

power cycle), the onscreen nomenclature took some guesswork without first reading the manual.

INSTALLATION

The installation on our G1 Cirrus was performed by Advanced Aviation in Lancaster, Pennsylvania. According to Joel Glover, director of maintenance at Advanced, his shop has performed nearly a dozen CiES fuel sender retrofits to date on a variety of Cirrus models. Despite the shop's experience with the installation, the aircraft was down for a week. The cost of the project was just north of \$5000, including parts and labor. The sensor kit has a list price of \$3000.

Nearly all of the existing mounting hardware is utilized when installing the new CiES sensors. While that simplifies the installation to a certain degree, it creates a compromise when it comes to absolute accuracy. CiES founder Scott Philiben says he has test data that proves the senders can yield tighter accuracy than you'll see in G1 and G2 Cirrus models.

"Installers have to put the new measuring floats in the exact same locations as the old ones to comply with the STC. FAA issues aside, it's not economically feasible to disassemble a wing and fabricate new nut plates to house the senders in a location that affords better measuring performance. While Cirrus made sizable improvements with the tank design (and the ability to measure fuel more accurately) in the G3 and G5 models, sensor performance in earlier models can be unpredictable by comparison," he said. Philiben adds that he strives for a two-gallon accuracy—a claim that we confirmed after flying our CiES-equipped G1.

As you might expect, proper system calibration is essential to accurate readings. This requires draining the fuel tanks and then adding fuel at two-gallon increments while the aircraft is exactly level. Our recommendation is to use a shop that has plenty of experience with Cirrus models and has accomplished at least several CiES retrofits. Contact www.ciescorp.com, 541-408-1095.



JUST HOW ACCURATE?

by Robert M. Dodenhoff

After transitioning to our first-generation Cirrus SR22 approximately 2.5 years ago, my wife and I have been extremely satisfied with the plane, but not so much with the performance of the original equipment fuel gauge. As an observation, the fuel gauges in most of the older general aviation aircraft I've flown are less than accurate, but I expected more from the system in our Cirrus.

Prior to each flight, I dipstick the tanks to verify the amount of fuel that's present. Before engine start, I set the measured fuel quantity within the Avidyne MFD fuel page. The integrated fuel totalizer keeps track of the amount of fuel that's utilized during the flight, based on fuel flow. I keep careful track

of the time versus fuel burn, while also keeping track of the time I change the tanks to maintain fuel balance. In our plane, I've learned to accept that the right tank fuel sensor can fluctuate in accuracy—anywhere from

as little as two to as much as 10 gallons, while in level cruise flight.

Recently, we were traveling with all of the seats filled, which meant departing with fuel filled only to the tabs in each tank to stay within specified weight and balance parameters. During the planning stage, my calculations revealed there would be sufficient fuel for the trip, plus enough to go to the alternate airport, if necessary.

Approximately five minutes prior to landing, a low fuel warning annunciator came on. It was both disconcerting and distracting. Obviously, several questions arose: did I miscalculate? Was there a fuel leak from one of the sump valves, or was it just the inaccuracy of the fuel gauge? We landed without incident and I immediately dipsticked the tanks again. Turns out my original calculations had been



correct and we had plenty of fuel remaining in the tanks.

Clearly, having the bogus fuel warning lamp illuminate was not a welcome distraction during the time of a high-workload approach and landing. The experience was enough to commit to the sizable investment of the CiES digital sender retrofit, (which also included the FL202G digital gauge.)

First, the presentation. There's far more useful data on the digital display than what's on the mechanical stock gauge. For instance, I like the dual-page presentation, including the page that simply reveals the fuel in each tank, measured to the tenth of a gallon. The other page includes a graph that outlines the fuel burn of each tank. Overall, the system is much better than the OEM setup. But it's not perfect.

A recent flight revealed a 1.7-gallon gauge discrepancy than what was computed from the fuel totalizer and from a crude measurement taken with the measuring stick. There are a few variables that could account for at least some error, including the need to extrapolate in-between readings taken with the fuel tank measuring stick.

While relying on fuel gauges shouldn't be a substitute for performing preflight and inflight calculations, the tighter accuracy of the CiES sensor in the Cirrus is a better resource than what we had before.

Contributor Robert M. Dodenhoff, M.D., is a senior aviation medical examiner and Cirrus owner based at Brainard Airport in Hartford, Connecticut.

Garmin GDL39 3D: Virtual Pitch and Roll

Garmin's updated portable ADS-B receiver puts an attitude indicator on the revised Pilot app. A smaller footprint would make it easier to manage.

by Larry Anglisano

Garmin's GDL39 portable ADS-B receiver is just one choice in a crowded market of capable low-cost solutions. In our view, the GDL39 has been shadowed by the competition because it lacked some of the advanced features that buyers might expect from a modern portable ADS-B receiver. For example, while other brands sport full AHRS functionality, the utilitarian GDL39 is stark, by comparison, offering little more than an integral Bluetooth GPS receiver.

The new \$849 dual-frequency GDL39 3D—in conjunction with

the updated Garmin Pilot tablet app—steps the unit up a notch, with a clever attitude indicator function. But it's not the glass panel lookalike you might expect. Instead, Garmin keeps it simple with an old-school onscreen attitude indicator, plus other supporting round-gauge instruments. We think the presentation is refreshingly simple and effective.

PILOT TABLET APP

Garmin's revised Pilot app (version 6.0 for iOS and version 2.8 for Android) is an integral part of the

GDL39 3D feature set. One of the beefs we've had with the Pilot app pertains to its lacking flight planning options, something that's enhanced with the new version.

When connected to a DUATS account, Pilot will retrieve a preflight weather briefing based on the parameters of the programmed active flight plan. A dedicated File and Brief tab allows the user

CHECKLIST



Old-school attitude indicator worthy of real-world backup.



Updated Pilot app has the flight planning capability we've been waiting for.



We're still waiting for a smaller GDL39. While rugged, it's also bulky.

to view the weather briefing for the route of flight. There's also the option to file and cancel a flight plan. Other menus within the app follow the architectural lead of Garmin portable GPS units. If you're familiar with any model in the Garmin aera series, the Pilot app should be easy to learn.

The new app also has a more modern appearance. According to Garmin, the app implements many of the design elements from Apple's iOS 7. That new look also includes the ability to overlay functions from several remote devices in a split-screen view, including the GDL39 3D, Garmin's VIRB Elite action camera and the D2 pilot watch.

The GDL39 3D connects to the tablet via Bluetooth and is managed in the Devices page. The integral AHRS function starts automatically during power-up and performs pitch and tilt leveling adjustments. While the unit doesn't have to be perfectly level, it does have to be pointed toward the direction of flight.

The attitude indicator is displayed in the Pilot app split screen mode by selecting the Panel page. The same menu allows you to select charts, terrain, flight plan and SafeTaxi airport diagrams as an alternate split-screen view.

We found the virtual attitude indicator surprisingly realistic, complete with the up-and-down-bobble

continued on page 32



The GDL39 3D, left, mounts on top of the glareshield and interfaces with the Pilot app, far left, via Bluetooth.

Simple Plug Checker: Go/No-Go on Resistance

Although it's a bit pricey at \$130, this gadget makes quick work of checking spark plugs for high resistance values.

by Paul Bertorelli

The list of approved maintenance items an aircraft owner can do under FAR Part 43 is long and includes replacing, cleaning and gapping plugs. In the spirit of cleaning, we think checking plug resistance is also on the list.

Like lowering your cholesterol and cutting back on salt intake, plug resistance wasn't always a concern, or at least one that anyone bothered with. But with the widespread use of engine monitors that can detect the slightest combustion anomalies, spark plug resistance has become the latest fine-point maintenance item owners need to worry about.

What's the problem here? As we reported in the November 2012 issue of *Aviation Consumer*, aviation spark plugs have a built-in resistor to keep the spark from becoming too energetic, which will prematurely erode the electrodes. However, if the resistance is too high, excessive lead fouling, inconsistent plug firing and high CHTs may result.

But what's too high? The nominal resistance of a new plug is 1000 to 2000 ohms, but as a plug ages, that resistance may double or triple or even more. One maintenance shop we know told us it found resistance as high as 15,000 to over a million ohms in some Champion plugs removed from

engines and found to be heavily lead fouled.

Although Champion disputes reports of high resistance in its plugs causing problems, its arch competitor, Tempest, argues otherwise. And Tempest believes that all spark plugs should be resistance-checked during routine maintenance, so they've developed a device to do this.

As shown in the photo below, it's nothing but a simple resistance bridge gadget with a go/no-go test protocol. It's called the AT5K, which means at 5000 ohms or more, the spark plug should be replaced.

We tried the AT5K on a half dozen plugs, all of which tested within limits. Using the

device is simple. Just mount the plug on a probe, which connects the harness end of the plug, then touch the tester's lead to the center electrode. If the indicator glows green, the plug is good; if it's red and green, the plug is serviceable. A red light indicates the plug's resistance is greater than 5000 ohms and it should be replaced, at least according to Tempest.

A couple of caveats. The plug should be cleaned before being tested, otherwise it's difficult to get the lead to make clean contact. Second, the plug should still be bomb tested to confirm a clean, robust spark.

At \$129.75 from Aircraft Spruce, the AT5K is a bit pricey for what it does, in our view. If you have a good multimeter, you can test plugs individually. But with some meters, the probe won't reach to the bottom of plug's center well and even it will, finding a good contact is awkward. If you've got a six-cylinder engine and check plugs frequently, the AT5K may be worth the investment. For more information, see tempest-plus.com or aircraftspruce.com.



Tempest's AT5K, right, is a simple go/no-go resistance tester that indicates resistance value via red and green lights, inset.

TV AT5K VIDEO



AVweb
www.avweb.com

Grumman Tiger

With an earned reputation for respectable speed, lively handling and a sporty cockpit, the Tiger gets high scores from enthusiastic owners.



Ask a Grumman Tiger owner what they like about the airplane and you'll likely get an earful of energetic praise. Most owners gush over the Tiger's snappy handling, healthy climb performance and slide-back canopy that allows for open-air flight. There's arguably lots of appeal to these little cruisers. Non-Grumman enthusiasts (and even some mechanics) just won't understand. Some call them silly little airplanes.

The population of Tiger airplanes is an aged batch—born in 1975, so owners were enthusiastic when the airplane went back into production in 2000 as Tiger Aircraft, LLC. It was a rejuvenated remake with some later

copies sporting ultra-modern Garmin G1000 glass cockpits. But that was a rocky return and it ended in 2007

The phrase "sports-car-like" is over-applied to aircraft, but true of the Tiger.

with financial turmoil and ultimate bankruptcy. Since, there's been lots of buzz of the airplane coming back but nothing close to real production has resulted.

EARLY HISTORY

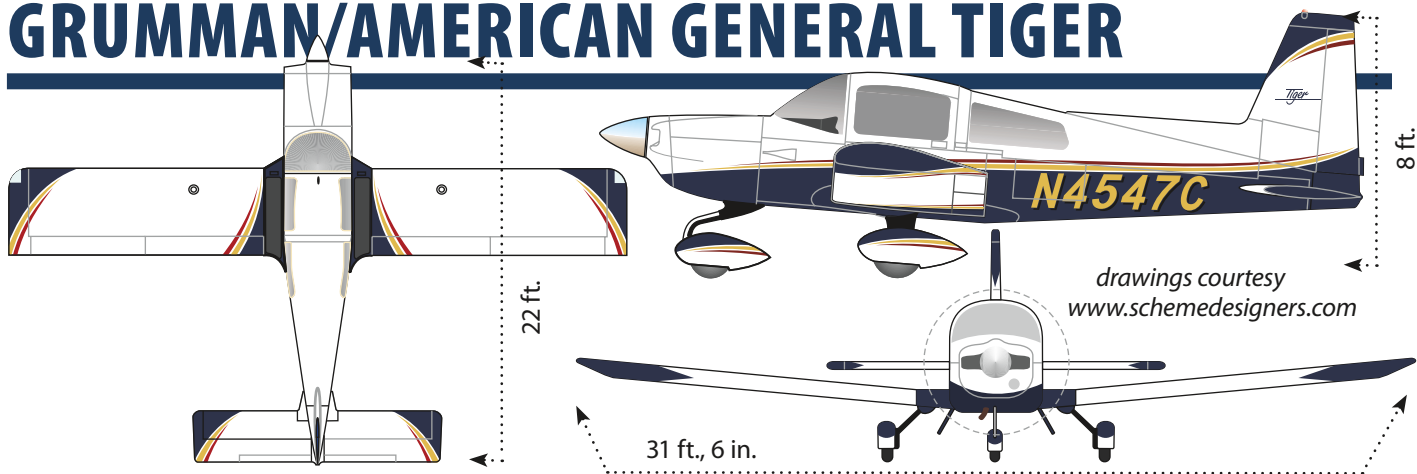
Flashback to the late 1960s when the model AA-1 Yankee designed by Jim Bede came on the scene. This was a two-seat airplane that was innocently

targeted at student pilots, but that proved to be a bad idea. The airplane was a bit too hotrod-like for students who were still on page three of their logbook.

As one Yankee owner put it, "I learned early in my first hours flying the Yankee that the airspeeds are to be respected. There's no margin for error." The Yankee featured revolutionary construction, aluminum-honeycomb sandwich fuselage panels and bonded skins. The fuel tanks were housed within a

Jim Viola's 2003 AG-5B, foreground of upper photo, won best of show at an American Yankee Association convention. That's a Cheetah in the middle slot.

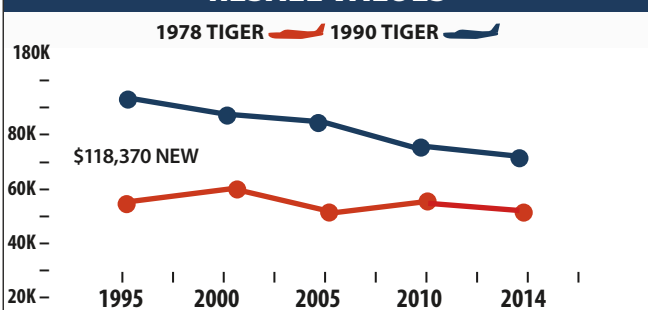
GRUMMAN/AMERICAN GENERAL TIGER



TIGER SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1976-1979 AA-5A CHEETAH	LYC. 150-HP O-320-E2G	2000	\$20,000	38/51	800 LBS	128 KTS	±\$34,000
1975 AA-5B TIGER	LYC. 180-HP O-360-A4K	2000	\$21,000	51	950 LBS	135-140 KTS	\$40,000
1976 AA-5B	LYC. 180-HP O-360-A4K	2000	\$21,000	51	950 LBS	135-140 KTS	\$42,000
1977 AA-5B	LYC. 180-HP O-360-A4K	2000	\$21,000	51	950 LBS	135-140 KTS	\$44,000
1978 AA-5B	LYC. 180-HP O-360-A4K	2000	\$21,000	51	950 LBS	135-140 KTS	\$46,000
1979 AA-5B	LYC. 180-HP O-360-A4K	2000	\$21,000	51	950 LBS	135-140 KTS	\$48,000
1990 AG5B	LYC. 180-HP O-360-A4K	2000	\$21,000	51	950 LBS	135-140 KTS	\$68,000
1991 AG5B	LYC. 180-HP O-360-A4K	2000	\$21,000	51	950 LBS	135-140 KTS	\$73,000
1992 AG5B	LYC. 180-HP O-360-A4K	2000	\$21,000	51	950 LBS	135-140 KTS	\$78,000
1993 AG5B	LYC. 180-HP O-360-A4K	2000	\$21,000	51	950 LBS	135-140 KTS	\$83,000
2002 TIGER AG5B	LYC. 180-HP O-360-A4K	2000	\$21,000	51	900 LBS	135-140 KTS	\$114,000
2003 TIGER AG5B	LYC. 180-HP O-360-A4K	2000	\$21,000	51	900 LBS	135-140 KTS	\$124,000
2004 TIGER AG5B	LYC. 180-HP O-360-A4K	2000	\$21,000	51	900 LBS	135-140 KTS	\$134,000
2005 TIGER AG5B	LYC. 180-HP O-360-A4K	2000	\$21,000	51	900 LBS	135-140 KTS	\$144,000

RESALE VALUES

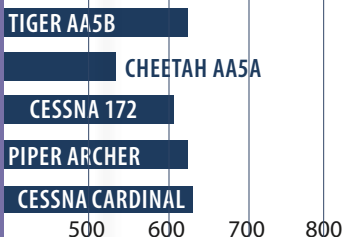


SELECT RECENT ADS

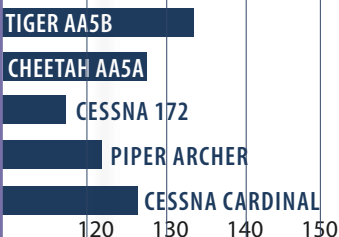
- AD 2006-12-07 ECI CYLINDER ASSEMBLIES
- AD 79-22-04 AILERON TRIM TABS
- AD 77-08-03 STATIC SOURCE VALUE OVERHAUL
- AD 76-22-09 OIL COOLER CHECK, REPLACEMENT
- AD 76-01-01 UPPER ENGINE COWL HINGES

SELECT MODEL COMPARISONS

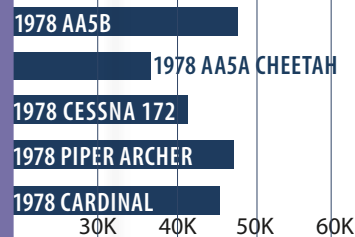
PAYLOAD/FULL FUEL, POUNDS



CRUISE SPEEDS, KNOTS



PRICE COMPARISONS





tubular wing spar. "They are stubby, underpowered, delightful little machines and I wouldn't trade mine for anything," remarked one owner.

Following the Yankee was the four-seat AA-5 Traveler from American Aviation. It had 150 horses under the cowl and more traditional fuel tanks. Gone were those dangerous sight-gauge fuel gauges that held avgas inside of the cabin. It was a different airplane.

The Traveler tried to compete with so-called complex aircraft such as the Cessna 177 Cardinal and Piper's PA28R-series Arrow with little success. It wasn't until Grumman stepped in, threw its money on the table and involved the famous Roy LoPresti to work his aero magic on the design. The result: the AA-5B Tiger.

The inside and outside of the cowl-

ing saw some changes including a 180-HP O-360 Lycoming that runs hot. More on that wart later. There was more fuel capacity and a different elevator plus some signature LoPresti and slick airframe mods. Many of these smooth mods made their way to the Traveler to mold the model AA-5A Cheetah (the Cheetah retained the lesser 150-HP Lycoming). To this day, the Tiger is the preferred machine and clearly more desirable than the Cheetah to many buyers.

The airplane was a reasonably brisk seller until production ended in 1979 after Gulfstream bought the line, where the focus was on building biz jets. Clearly, Gulfstream is a success story with or without the little Tiger. Perhaps Gulfstream knew something Cessna didn't when it pulled the plug on the Tiger. The industry subsequently tanked and Cessna threw in the towel shortly thereafter on its single-engine line of pistons. It was an ugly climate—worse than today.

REBIRTH

Flash forward to the late 1980s when the Tiger was born yet again at American General, who introduced the AG-5B around 1990. This lasted until 1994 when the company flat-lined. The parts inventories and rights were sold to Fletchair, one of the two main suppliers of Tiger support and a distributor for new factory parts.

When it comes to avionics upgrades, anything goes in a Tiger. There's plenty of room to work with. This panel sports an Aspen PFD, a big-screen MFD and IFR GPS, upper left photo. The fuel selector, bottom photo, is easy to access.

Original production for the AA-5B was 1323 airplanes, while 900 AA-5As were built. A total of 834 AA-5 Travelers were produced, as well. American General built around 150 AG-5Bs before it folded. There were no major design changes during the Tiger's production run, although there were some refinements. In 1977, much-needed soundproofing was improved and windshield thickness doubled to a quarter-inch. Other changes included minor aerodynamic refinements, including rubber fairings on the landing gear, improved windshield sealing and the addition of a nose-strut shock absorber. In 1978, the iron-butt-inducing seats were improved, and U-strips were added to the trailing edges of the control surfaces to prevent delamination of the bonds.

NO FRILLS

We wouldn't exactly call the Tiger luxurious. It's stark and has a relatively no-frills dwelling, but this adds to some of the appeal. As with most airplanes, anything goes in the avionics retrofit world. Grumman owners load oodles of electronics into the panel, including Aspen and Garmin glass displays, advanced autopilots and color engine monitors.

Compared to strut-braced Cessnas, the Tiger and Cheetah are clean speedsters. The Tiger has a published book cruise speed of 139 knots but owners generally plan on real-world speeds of 130 to 138 knots. This isn't chump speed, since the AA-5, by virtue of its slab-sided honeycomb panel fuselage, is hardly slick in the drag department. Hard chines run along the lower corner of the fuselage and the wing-fuselage junction has no fairing to smooth interference drag.

The saving grace here is the bonded construction with flush rivet heads. The Tiger is the fastest of the line, since the Cheetah makes 12 knots slower, with the Traveler bringing up the rear and slower yet, but

will still blow away a 150-HP Cessna Skyhawk or older Warrior. Later 160-HP versions of the Warrior, with speed pants, can just about run with a Cheetah, however.

Where Skyhawks and Cherokees could have a slight edge is in climb. At sea level and standard temperatures, the Tiger moves out at 850 FPM, about on par with the competition. (With a climb prop, a Tiger may see 1000 FPM.) But throw in high density altitude and the Tiger's climb performance sags behind the Archer and Cessna's strutless Cardinal. The Cheetah, with 30 fewer horsepower, can be a dog in hot-weather climbs. The Yankee is worse.

Some energetic and skilled Tiger owners tweak as much climb as possible from their airplanes—essentially ignoring the book procedures and climb with some flaps hanging out. If the takeoff includes clearing some obstacles on the other end of the runway, taking off with one-third flaps might get the job done less the pucker factor.

LOAD, RANGE, HANDLING

Gross weight of the Tiger is 2400 pounds and typical IFR aircraft run 1450 to 1500 pounds empty. That leaves a useful load of about 900 pounds for the 180-HP four-placers. That's enough for full fuel (51 gallons) and three adults, plus a little baggage. The Cheetah has an empty weight only slightly less and a gross of 2200 pounds with useful loads around 750 pounds. Since the Cheetah is a weak climber, loading full fuel into the optional 51-gallon fuel tanks makes it a two-place airplane.

But loading might not be a huge issue anyway since the Cheetah lacks any remarkable baggage space. Any heavy items like large golf bags or snowboards need to come into the cabin and be laid over the back seat. Center of gravity is normally not a problem in either the Cheetah or Tiger, which is a good thing.

The Tiger's 51-gallon fuel capacity yields about four hours of endurance with reserve—a pretty good fit for the aircraft.

Realistically, you'll need to plan on still-air range with full fuel in the tanks to be about 500-plus miles. The standard-tank Cheetah, by comparison, has shorter legs. The 38 gallons you pump into it is good for a bit less

TIGER PRANGS: ENGINES, CREATIVITY

We were struck by two things as we reviewed the most recent 100 Grumman Tiger accidents: That there were only slightly more than 100 total reported accidents for the fleet and, for having a reputed "bulletproof" engine, there were more engine failure events than we expected—although most could be traced to poor maintenance.

The Tiger's Lycoming O-360 engine also has a reputation for being at low risk for carburetor icing, yet of the engine-related accidents, the probable cause of three was carb icing. In addition, the circumstances of at least three with the cause of the power loss listed as "unknown," strongly suggested carb ice.

One Tiger pilot had a forced landing after the fuel filter of his recently painted airplane became blocked by paint chips. There were four misadventures with propellers: one broke a blade, two simply departed in flight after being poorly secured and a pilot's mother walked into the prop as he was doing his runup and concentrating on the instruments.

Accidents on or near the runway accounted for 27 Tiger mishaps. The events generally started with the pilot flying the speedy little airplane down final way too fast, floating, drifting and touching down awkwardly. The ballet progressed either to whistling off the side of the runway and hitting something, being unable to stop in the space remaining, or attempting a go around and hitting something before or after getting back into the air.

There were a surprising number of VFR into IMC accidents, nearly all of them fatal. One involved the inflight breakup of the airplane.

After exhausting the ordinary ways of tearing up airplanes, Tiger pilots got creative. The 180-HP Tiger is known for pretty good climb performance, especially when compared with its 150-HP sibling, the Cheetah. Yet, at least five Tiger pilots tried to get more performance out of the airplane than was ever

built in. They loaded them up and departed in conditions that were some combination of too warm with a runway that was too short, too high or had too much slope. Four hit obstructions—two got past the immediate threat and then stalled and crashed.

Brake failures put airplanes off the sides or ends of runways and taxiways. One instructor, after his student said that the airplane kept wanting to turn left while taxiing, took the controls and taxied up and down a taxiway trying to fix things. That is, until smoke was detected coming from the left landing gear. Instructor and student evacuated the airplane before the brake fire consumed the airframe.

Four Tigers were written off after the loose nut on the control yoke decided to engage in buzz jobs. One hit power lines, yet managed to stagger on for another mile before hitting a second set of power lines. It went no further.

Well into the takeoff roll, one pilot discovered that the reason the control yoke wouldn't move aft was because the gust lock was still firmly in place. The pilot tried to remove the gust lock for a while before closing the throttle, hitting the brakes and, eventually, the fence.

During rollout from a normal landing, a Tiger had a Cherokee land on it. Amazingly, the Cherokee went around successfully. Both airplanes were damaged, but no humans were hurt.

ACCIDENT SUMMARY

■	ENGINE/MECH (23%)
■	OTHER (19%)
■	RLOC (17%)
■	VFR TO IMC (14%)
■	GO AROUND (10%)
■	STALL/SPIN (6%)
■	BUZZING (4%)
■	TAKEOFF (4%)
■	BRAKE FAILURE (3%)



The sliding canopy adds to the Grumman's sporty cockpit and sports-car-like appeal. The price to be paid is a semi-awkward ingress. Pop the seat cushion off its pan to spare wear and tear of the upholstery, lower photo.

These airplanes have a swiveling nosewheel (it doesn't caster all the way around) so taxi is accomplished with brakes. As with any castering nosewheel, this takes some skill. Experienced Grumman pilots know just the right amount of speed to make the rudder effective for most turns.

If you try to push a Grumman back into its tiedown without a tow bar to help, you'll risk both damaging the nosewheel and create a comedy show on the ramp. And when it comes time to chock the airplane, put the chocks under the mains and not under the nosewheel.

The drill for slipping the surlies in the airplane consists of riding the brakes a few seconds until the rudder comes alive after angling the airplane a bit right of centerline. Once engine torque starts kicking, the wheel straightens and it's off the brakes pretty quickly. Pilots new to the Grumman get all kinds of tense about that castering nosewheel, but there isn't really much to it.

OPEN CANOPY

Talk about Grumman Tigers and the first thing that comes to mind is that

fighter-jet-like sliding canopy. We've all seen the ads of pilots with both arms out the canopy in flight grinning like goats. This slick canopy makes getting in and out of the airplane a minor challenge if you have stiff muscles. Plus, you'll get wet in the rain, but rewarded with excellent ventilation on hot days during taxi (and in flight).

That show-off canopy, however, can take its toll in a crash situation. There's a chance pilots will get trapped in the aircraft if the fuselage bends or warps to the point where the canopy can't slide open. Keep a hammer in the aircraft to smash your way out if you wreck. Consider protecting the two pieces of the canopy lock to keep it from smashing and jamming.

The Tiger's interior and panel have stood the test of time, although many airplanes sport cracked interior pieces and broken instrument panel trim and overlays. This is true of most vintage airplanes, but there's lots of plastic in a Grumman. The fuel selector is idiot-proof, although without a "both" selection, it does require switching tanks. For the fuel-management challenged, the switch is intuitive with arrows pointing to the active tank. The selector is conveniently located and quite visible.

Working the electric flaps is accomplished with a toggle switch up on the center pedestal/console, but you'll need to look down at the indicator to see how much flaps are hanging. Experienced Tiger pilots tend to simply count to five for half flaps. A slight quirk of the switch is that if you hold it down to extend the flaps and let it go, it snaps back over center and retracts them again. Gotta watch this.

The Tiger/Cheetah interior is comfortable, and the panoramic visibility and canopy view makes it feel roomier than it really is. Linebackers will complain about lack of shoulder space. A unique and useful feature of the cabin is the fold-down rear seats, which provide a six-foot-long cargo compartment that will hold a couple of mountain bikes, several golf bags or ski equipment for those excursions to the mountains.

MAINTENANCE

Mechanics access the engine through the split cowling and in general, the Grumman is designed to be easy to

than four hours, with reserves. This equals about 450 miles. As a two-placer with the optional 51-gallon tanks full of fuel, the Cheetah will fly a lot longer than you'd be comfortable staying in it. As for handling, proud owners are spot on when they say the Tiger is a sports car of the skies. It's light and responsive with somewhat touchy controls, which really makes it an autopilot airplane for hard IFR. The popular autopilot for the airplane is of course the S-TEC 20 or 30 with altitude hold.

Landing is a reasonably easy affair in a Tiger (the Yankee, on the other hand, sinks like a flying manhole cover when the power is pulled off). Owners will say the airplane floats and adding insult to injury, coming in with extra speed in the airplane is a setup for the classic runway over-run—a common thread in the wreck reports.



During taxi, top photo, the Tiger's castering nosewheel can play with your emotions. Lycoming's parallel valve 180-HP O-360, bottom, is easy to access under a hinged split-cowling.

service. It's a simple airplane with no retractable gear, hydraulics or other complicated systems. As a result, owners boast of low operating costs and excellent dispatch records.

A wart in the design is the absence of cowl flaps and the tightly-cowled engine has been known to run hot. Caring for the engine baffling is a must and many owners advocate engine monitoring systems. These monitors have been known to register upwards of 450 degrees, a big number for a low-output four-cylinder engine.

Although it shouldn't be a problem for any current airplanes still flying, bond-line separation plagued a few early models. The culprit was an improper bonding sealant, American Cyanamid FM-123, known as "purple passion" among production employees. The FM-123 was used in all Grumman American aircraft built

between April 1974 and December, 1975—including Tigers up through about serial number 125.

At least one delamination occurred in flight in a 1975 Tiger, but no accident resulted. At least two Tigers, serial numbers 15 and 19, were virtually rebuilt from scratch because of bonding problems. According to a former production employee, 30 or 40 honeycomb fuselage test panels somehow found their way into production aircraft, possibly affecting Tigers with serial numbers below about 30.

A 1976 AD required rivets along bond lines and the problem has since receded. But any buyer of a 1975 or early 1976 Tiger should be aware of the potential for problems. You can check for the defective glue by pulling off the wingtip and inspecting the bonded seam at the spar-to-rib or rib-to-skin joint. If there's a purple line, you may have a problem.

The Tiger/Cheetah castering nosewheel can induce shimmy. Improper tensioning in the spring washers, sloppy torque tube struts, worn tires and loose axle nuts all contribute to nosewheel shimmy. If there's a single piece of hardware on the Grumman that requires attention and extra care, it's this nosewheel. Lube it and adjust it by the manual is the requirement. (Not many shops have the manual and readers tell us that improperly performed maintenance on used airplanes for sale is common.)

The 1977 and later models have

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That's not a Tiger, above. In fact, it's unlike most other Grummans. It's Michael Gillespie's completely restored 1973 AA-1B with a DMA conventional landing gear conversion. When it's not dragging its tail, it cruises at 145 knots.

a shock absorber in the nosewheel, which helps, but these make removal of the nose gear a pain in the shorts. If you have persistent shimmy problems, see a mechanic who specializes in Tigers. And this is a good time to mention something odd: We're not sure why, but some mechanics and shops in general shy away from Grummans—a snub of sorts. Several shops told us that some Grumman owners tend to bellyache about maintenance costs when they surface because they're caught up in the "little airplane" mentality. The Grumman may look like a little toy, but it's a real airplane that requires real maintenance. Don't expect a free ride from most mechanics when the airplane hits the shop.

Pre-1979 Tigers (s/n 1047 and below) had problems with cracking spinners, possibly related to propeller vibration. Virtually all Tigers in the field have been retrofitted with improved spinners, but check to make sure. One experienced Grumman mechanic who wrote to us says that even the new spinners have problems.

The Tiger was an early pioneer of the current trend toward castering nosewheels and that means brake pads wear quickly. Although savvy pilots learn to taxi with minimum braking, good brake maintenance is important. Several owners reported repeated breaking of the rudder

springs and one owner told us he always carries a spare, just in case.

Just like Mooneys, Tigers have wet wings and it's not uncommon to smell leaking fuel. An AD addresses the fuel tank sealant.

The airplane is relatively AD-free but there are two significant inspections: one 200-hour inspection of the McCauley prop hub for cracks and a 100-hour inspection of the ailerons.

One potentially onerous AD cropped up in 1998: AD 98-2-8 calls for inspection of the hollow crankshafts bore for corrosion pits or cracks. It's a shotgun AD that applies to a number of airplanes with Lycoming engines. If nothing turns up, an anticorrosion treatment takes care of the AD once and for all. If cracks are found, the crank needs to be replaced, and if corrosion pits are found, the AD becomes a 100-hour repetitive inspection until a new crank is put in at overhaul.

PARTS, MODS, CLUB

The Tiger is unusually well supported, in our view. Fletchair (800-329-4647 and www.fletchair.com) has long specialized in Grummans. When American General folded, Fletchair acquired the parts inventories and manufacturing rights. FletchAir, Inc. is known worldwide as the single largest manufacturer and distributor of parts for American, American General, Grumman-American and Gulfstream-American copies.

David Fletcher, president of FletchAir, has grown up with the Grumman family of aircraft and has been a stocking Grumman dealer since 1974.

Air Mods NW (www.airmodsnw.com) does wing repairs, refurbishments and upgrades, and has a number of STCs for the Tiger. Air

Mods also sells oil coolers and a baffle modification that reduces oil temps by 25 to 40 degrees. This is a worthwhile mod in our view, given the heat these engines throw.

Air Mods can turn Travelers and Cheetahs into Tigers with a 180-HP conversion. They also can convert Travelers and Cheetahs to constant-speed props and install split nose and lower cowlings, plus wingtip and wing-skin embedded halogen landing lights and roller canopy tracks. They can also handle honeycomb and wing repairs as well as interior and engine work.

Fletchair has a split nose cowl STC, which eliminates the need to take off the spinner and prop to get at the starter, alternator and front engine baffles. This applies to the 1975 Traveler up through the 1979 Tiger. The AGAC Tiger already has a split nose bowl, as do the newer Tigers that came from Tiger Aircraft.

Another recommended mod is a Sensenich propeller in place of the AD-plagued McCauley. This also eliminates an annoying RPM restriction between 1850 and 2250 RPM in descending flight—right at the usual ILS approach speed. Unfortunately, installation is not intuitive and common installation errors have led to problems with the bulkhead and/or propeller attach bolts.

Other mods of note: Approach Aviation (www.approachaviation.com) has a ram air induction kit; Powerflow (www.powerflowsystems.com) has a tuned exhaust system.

There's AuCountry Aviation (www.aucountryaviation.com) and of course, LoPresti Speed Merchants with cowling modifications (www.speedmods.com).

Grumman owners enjoy one of the best owners groups around, the American Yankee Association. It has an excellent newsletter and serves as a pipeline to technical expertise. The group also has a special group insurance plan that may save you money and can direct you to approved instructors for Grummans. Contact www.aya.org. There's also The Grumman Gang (www.grumman.net).

READER FEEDBACK

I'm now over a few hundred hours in Grumman Tigers and they are a consistently dependable and simple aircraft to fly. Admittedly, learn-

ing to fly a Tiger after training for 70-plus hours in a Piper Warrior, my first reaction was that they were a bit touchy and difficult to control. Now (and after only a few hours with a Grumman-savvy instructor), I understand that they respond well to a light touch, are truly a sports car of the air and are safe when flown with an eye to some key numbers on approach. The agile handling and extreme ground maneuverability are a fine combination. These are fun, fast aircraft to fly.

The best safety recommendation I heard when learning to fly then was: "Don't land these aircraft too fast." Many C and P brand pilots don't have experience with aircraft with smooth skins, and are more used to the draggy flight characteristics of planes with rivets on the wings and fuselage.

The Tiger will glide better and will not bleed off speed as fast as some aircraft. Speedwise, 70 knots crossing the threshold is a good target, which generally equates to somewhere near 1500 RPM with full flaps on final. If you bring it in too fast, it will not just flop to the runway. Set up a controlled approach and manage airspeed for a highly predictable result.

The compact cowling can create some cylinder overheating problems if the mixture is too lean or the baffles are in bad shape. Cowling mods are available from a number of sources that offer better cooling and lower drag than the square inlets native to Tigers.

It's important to keep cylinder temps under 400 degrees F in cruise to minimize coking on the valve guides and reduced cylinder life. Lean aggressively on the ground to avoid lead build-up on the lower plugs and use a lead scavenging run at the end of the flight (run up to 1800 RPM, lean, wait 30 seconds) to keep things clean.

Older aircraft typically do need parts to replace some of the original ABS plastics and I've replaced the horizontal stabilizer on two different aircraft with fiberglass.

Parts and support are very available, with great customer care from Fletchier and a cadre of talented A&Ps that can handle these birds is easily reachable through simply asking on The Grumman Gang (www.grumman.net).

Painting requires working with someone who knows how to handle the bonded wings, but there are many of those shops around.

These aircraft flight plan at 130 knots almost universally. They typically get 700 FPM climb at lower altitudes and 90 KIAS even in warm weather. My plane burns about 11 gallons per hour at 8000 feet, leaned out, has almost a four-hour cruise capability (maintaining reserves) on the 52-gallon tanks, of which only 50.5 are usable. Still, that's bladder-busting endurance.

I pay about \$1000 a year for insurance for a VFR pilot. Annuals run about 20 to 24 hours of time (I have a great A&P in Forest Hill, Maryland) and unless I'm installing a new tach or fuel flow or doing something else that's an upgrade, I can predict a reasonable annual expense.

Two full-sized bicycles fit well into the cargo bay (front wheel removed) when the rear seats are folded down or removed. Simple, fast and capable of hauling three 200-pounders even with full fuel (mine has a 930-pound useful load), this versatile aircraft is a great value and performer.

Peter Langlois
Leesburg, Virginia

After earning my private pilot license in 1997, I joined a flying club and flew a 1974 Cessna 172 and a newer Piper Archer II. After a year, I realized that we could make good use of an airplane if it were available on our schedule. I read about the Grumman Tiger and was impressed with owner comments and its speed relative to others in its class.

After a brief search, I found a 1977 Tiger that was in good condition but could use some avionics, paint and interior upgrades. I've continued to upgrade my Tiger since purchase, adding a Garmin GNS430W, an EGT/CHT gauge (which I consider a necessity), new paint and interior. My Tiger is IFR certified. It is a very competent instrument platform.

I've had my Tiger for 12 years now and have flown between 70 and 100 hours per year. Among the more lengthy trips my wife and I have taken were from Princeton, New Jersey, to Cody, Wyoming, Fredericksburg, Texas, and last year to Red Deer, Alberta. We did the return

trip from Texas to New Jersey in one day—about 12 hours with two fuel stops.

Maintenance and annuals are pretty straightforward, with no more than the usual surprises. The simplicity of the design and lack of constant speed prop and retractable gear reduce maintenance costs and improve reliability. Even without that complexity, I routinely cruise at 135 knots and could wring another couple of knots out of it if I didn't mind wasting fuel.

The American Yankee Association, the club for all Grumman aircraft, is a great support group, with helpful experts willing to share their expertise. Plus, there's a great annual convention.

Larry Tatsch
Ringoes, New Jersey

I've been flying Grummans since 1978. I soloed in an AA1C and got my ticket in an AA5A. In fact, four out of the five planes I've owned have been Cheetahs or Tigers. I've flown over 3000 hours in all single-engine Grumman makes and models. I liked them so much, I quit my job as an F-16 propulsion engineer at Edwards AFB to start my own company (www.aucountryaviation.com) to maintain, repair, modify, service and sell only Cheetahs and Tigers.

In 2009, my STC for a completely new fiberglass cowling was approved. To date, 16 have been sold and 14 of them are flying. The prototype plane was 8 knots TAS faster with the new cowling and the flight test plane was 6 knots TAS faster with the new cowling. Both planes showed a significant decrease—up to 30 degrees in CHT—over the stock cowling. I'm currently making small changes to try and squeeze another knot or two.

I'm installing an IO360-B1G6 into my Tiger to become an STC that allows the use of a constant-speed prop. Unlike the IO-360-C1C6 200-HP angle-valve engine, the parallel-valve B1G6 uses all of the existing baffles, engine mount, airbox and most of the plumbing and cables. I'm in the final stages of obtaining PMA for aluminum instrument panel overlays and a fiberglass eyebrow kit.

Gary L. Vogt
AuCountry Aviation

GDL39 3D

(continued from page 22)

motion you would see on a spinning iron gyro. The electronic horizon is plenty sensitive, without the data lag that we're accustomed to seeing with other portable AHRS units.

The attitude display is supported by other backup instruments on the Panel page, including airspeed, vertical speed, altitude and track heading. While these are GPS-derived, we think they have plenty of value in a backup situation.

In addition to the attitude function, Pilot 6.0 and 2.8 display recommendations for flying right-hand traffic patterns at specific airports. This data is accessed in the Airport page by selecting the Runway tab. There's also special use a new air-space frequency function.

If you fly with an adventure camera, we think Garmin's VIRB Elite is worth a look (only the Elite model is compatible with the app). For cockpit use, we prefer the VIRB's feature set, menu structure and battery endurance over the GoPro Hero. The new Pilot app takes the camera interface to a higher level since it can display the VIRB's video on a dedicated split screen. This also allows you to start and stop the camera's recording and photo function. The VIRB connects to the iOS device with a WiFi connection and has a list price of \$399.

The GDL39 3D is compatible with Garmin's aera and 695/696 series GPS, but won't display the attitude indicator. It's planned in a future revision, as is synthetic vision. Contact www.garmin.com, 800-800-1020.

Safety Refurbs

(continued from page 10)

accompanying high vertical velocity can overcome all crashworthy protections.)

We like vortex generators (VGs) because they weigh almost nothing, reduce stall speeds measurably and improve low-speed handling—which is important in a forced landing. We reviewed VGs in the June 2012 issue and are of the opinion that not only are they a benefit for overall operation of the airplane, they reduce the risk of injury in a forced landing by allowing a slower touchdown.

VGs are available from a number of suppliers. Cost before installation, ranges from as low as \$700 for a small single to more than \$4000 for a turboprop twin. Installation on even the most complex airplane usually takes less than a day.

EGRESS

Get rid of the cords. Have you looked around the cockpit once you're strapped in and counted the number of cords that can snag you as you're trying to beat feet out of the airplane? When seconds matter, cords can take those seconds away. We won't try to list all the cordless and Bluetooth devices available—but as you evaluate your next headset or portable purchase, consider whether it has a cord that could cause trouble.

ACTIONS

Over many years of looking at general aviation accidents, we've been pretty impressed with the overall crashworthiness of GA airplanes.

FEEDBACK WANTED

DIAMOND DA40



For the June 2014 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Diamond DA40 series, the four-place, composite single. We want to know what it's like to own these planes, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your airplane to appear in the magazine, send us any photographs you'd care to share. We accept digital photos e-mailed to the address below. We welcome information on mods, support organizations or any other pertinent comments. Please send correspondence on the Diamond DA40 by April 1, 2014, to:

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e-mail at:
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Production aluminum and composite airframes do a pretty good job of crushing while performing their last design function of absorbing energy—although we do not like airframes with fuel in front of the occupants.

Nevertheless, a refurb can measurably increase the chance of survival. Plus, with a little thought, the pilot can do much to take advantage of the built-in crash protection—through selection of terrain, touching down slowly, but not stalled, and flying the airplane until it completely stops moving. Pilot technique is beyond the scope of this article, so we recommend an article on the subject in our sister publication AVweb.com at <http://tinyurl.com/n6hsxfj>.