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The Aviation Consumer®

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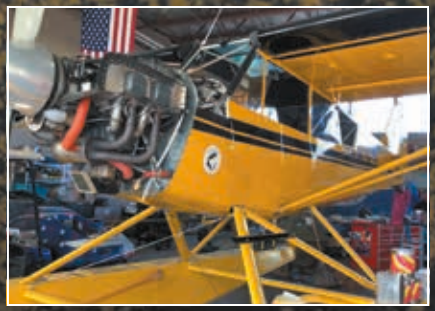

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The Aviation Consumer

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HOW WE BREAK AIRPLANES

Stupid pilot tricks, anyone? Here at the magazine some of our test aircraft for sending portable products through the wringer are Cessna 150s and 152s—seemingly the best combination of budget-friendly economy, durability and simplicity. Flying and filming the Faro Stealth headset in the 150 for the field report in this issue got me thinking about the hard-as-steel insurance market, and how we bust airplanes. Even simple Cessna 150s.

The photo down below is a tailcam capture of yours truly putting the airplane down for the day after a headset testing session. Forget that I'm off the centerline. The smoke plume coming off the left main is my size 10 day-hiker resting on the left toebrake as I plopped the Cessna on the pavement, lips narrating on camera and a left leg draped with headsets. Add to the mayhem the MyGoFlight camera mount that lost its suction and came crashing down in the flare. I now understand why pilots who've flat-spotted a new Michelin to the point of blowing it out (I didn't, thankfully) are dumbfounded as they watch the tug pulling the airplane off the runway and to the nearest maintenance hangar.

Maybe my on-the-job stupid pilot tricks will save someone some new rubber. I confessed my sloppy stick and rudder to Senior Editor Rick Durden, who suggests calling out "heels on the floor" before crossing the threshold. While I'm at it, I'll call "cut" and consider ditching the test products from my lap before getting close to the ground. Man, what a mess. But when it comes to stupid pilot tricks, I'm in rotten company at least according to some of the wreck reports we salivate over when preparing the monthly Used Aircraft Guide. There are some doozies.

Sometimes it's best not to touch anything, as was proven by the pilot of a Columbia who, according to the NTSB, on climbout spotted a carpet strap hanging out the door. The POH strongly warns to not open any doors in flight, but when he did the door was violently pulled from his hand, came off the airframe and smacked the wing and tail. Insurers paid big bucks to repair the busted composite and a lacerated hand. If pilots don't have enough tricks up the sleeve, sometimes the folks who wrench the airplane can help, while a chain of calamities finish the job.

That was in one report when the pilot of a twin Cessna fetched the airplane from a shop after an engine repair, only to ferry it to another shop to have uncompleted landing gear work done. With the problematic landing gear down, the repaired engine lost all of its oil and failed. No, even with the propeller in feather a Cessna 310 won't hold altitude on one engine with the landing gear extended. But it will ding the insurance claim. But maintenance troops aren't always to blame. One pilot decided to ferry his Cessna Skymaster for maintenance after the interior—and fuel tank selectors—had been stripped out. The idea was perhaps to save some shop teardown labor, but it ended up costing the insurance company when the airplane ran out of gas because the pilot couldn't switch tanks.

For more lighthearted reviews of stupid pilot tricks worth etching into the learning bank, I'll plug the January 2020 issue of sister publication *IFR Magazine*, which each year dedicates a full article on the topic.

GOT ADS-B?

Speaking of January 2020, the date on this issue of *Aviation Consumer* matches the long-dreaded ADS-B Out deadline. Rest assured, our coverage won't stop. You haven't seen the last of products and accessories that support the equipage mandate, but we need your help. If you still haven't equipped, we want to know about scheduling, costs and even more important—if you have equipped—how your existing gear is working in the system. If you have to work your way through ADS-B airspace and the airplane doesn't have ADS-B Out (or your system isn't working), give us a field report.—*Larry Anglisano*

WHICH GPS NAVIGATOR?

Your IFR GPS roundup article in the September 2019 *Aviation Consumer* proved incredibly resourceful as I shopped for a system to go in my Mooney. I agree with your assessment that for many of us it's worth the savings to go without ground-based VHF nav capability, including ILS. I ended up with Garmin's GTX 375 and dual G5 displays.

For others wrestling with the decision, my conclusion was pretty easy. I looked at the airports I typically frequent, including my field in North Carolina, and found that every single one of them was served by a precision GPS approach, some of them with lower minimums than my own personal ones.

When my shop put a price on both the VHF-equipped Garmin GTN 650 (the larger GTN 750 wouldn't easily fit in my stack, the shop said) and the GPS-only GNX 375 the savings was over $2000. The unit also solved my ADS-B equipage dilemma with its built-in ADS-B transponder, which replaced a failing Narco AT150. I kept the existing King KX155 since the Garmin doesn't have a VHF comm radio—a major shortcoming, I think.

Cole Matherson
Raleigh, North Carolina

Garmin offers a version of this navigator with a VHF comm radio, the GNC 355. It's $6995 compared to $7995 for the GNX 375. However, the tradeoff is the version with the comm doesn't have a built-in ADS-B transponder.

NEW CIRRUS TRAINER

As an owner of a Beech Musketeer with a fake landing gear switch, I was interested in your article on the new Cirrus TRAK SR20 trainer, which has a landing gear simulator. Question is, does this landing gear simulator system make the TRAK fair game for logging complex airplane experience for earning the commercial certificate?

Peter Hasset
via email

No. The landing gear simulator in the SR20 trainer is for procedural training only. But it doesn't matter. Previously an applicant had to train 10 hours in a complex airplane—an airplane with a retractable landing gear, controllable-pitch propeller and flaps.

But the FAA now allows the training to take place in a technically advanced airplane, or TAA. That's defined as an airplane with an electronic primary flight display that has all six primary flight instruments, an electronic multi-function display with a GPS-based map display and a two-axis autopilot with heading and navigation modes. With its integrated avionics, the SR20 TRAK checks all of those boxes.

CANADIAN ADS-B BEEF

When you read Nav Canada's literature on the proposed ADS-B tech (which would require top and bottom L-band antennas) you have to wonder why they require a bottom mount antenna at all in new world of Aireon. There is no mention of a terrestrial network at all, so why complicate the solution?

Of course the answer is that they currently do have a network of radars, both SSR (secondary) and PSR (primary), covering the important parts of the country. Are there plans to turn off these services? Well, they are about to start. The PSR segments of three radars are currently on the chopping block. Here in Canada we are told that a PSR isn't needed, even at recovery airports in this new world. The weather detection of these radars isn't needed either, as the function was already turned off. But the worst part is the surviving secondary radars were designed in the 1980s and are worse than obsolete.

The question for all of us is why is Nav Canada insisting on a single solution for a critical surveillance system that is incompatible with general aviation? As stakeholders in Nav Canada we ask, "Why did you spend $150 million without asking us?" Why not update the radars and add ADS-B/FIS-B for useful real-world capability? Please unlock the safety features of ADS-B in Canada without burdening us with cost and complexity. Aireon is not a solution for safety, it is a way to bill and track us.

Lee Coulman
via email

On The Cover: That's the Collier Trophy Award-winning Cirrus Vision Jet G2. The G2 is the second-generation Vision Jet since the airplane earned type certification in 2016. The G2 has a higher operating ceiling, an improved cabin, autothrottle and Safe Return Emergency Autoland. The flight trial article begins on page 4.

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Cirrus Vision Jet G2: Higher, Quieter, Safer

For $2.75 million, the second-generation Vision Jet has autothrottle, an improved cabin and will have Safe Return Emergency Autoland.

CHECKLIST

- It's not blistering fast, which makes it a good step-up turbine.
- But it's fast enough, and made more efficient by a 31,000-foot service ceiling.
- With Emergency Autoland, autothrottle, CAPS parachute and an advanced autopilot, it could be the safest equipped plane.

If its success with the SR-series piston line isn't impressive enough, Cirrus has delivered nearly 150 SF50 Vision Jets since earning the type certificate in 2016. As was the plan, the majority of those buyers stepped up from million-dollar SR-22T piston models.

BY LARRY ANGLISANO

And with order books full for the single-engine jet, Cirrus has been working on improving the Robert J. Collier Trophy award-winning airplane. Some changes to the G2 (for second-generation) are major and others are subtle, but combined they make an already impressive airplane better in a lot of ways.

The Vision Jet I flew for this report had the Safe Return Autoland system, which is currently in certification and will be standard. We covered it extensively in the December 2019 *Aviation Consumer*, so we'll only touch on it in this report.

TWEAKS BIG AND SMALL

Other than the G2 markings on the paint work, you can tell a second-gen Vision from a G1 by looking at the surface of the wings. Gone are the boundary layer energizers (BLEs) that were intended to create a turbulent airflow over the wing so the flow doesn't separate before hitting the ailerons. Roll-axis handling seems even better after ditching the BLEs and by adding a simple tab on the trailing edge of the ailerons, catching the airflow so the control surfaces remain as effective. Stall speed with the gear and flaps down at the 6000-pound MTOW is 67 knots.

Overall, the airframe's construction is unchanged, although the V-tailed structure is still interesting to look at and there's some clever aero engineering going on. As you'd expect from Cirrus, the fuselage structure is primarily carbon fiber. The forward part up to the aft cabin bulkhead station is fabricated separately and assembled in a fixture, as is the tailcone. The carbon fiber structure below the jet engine is covered by a titanium firewall. Yes, the Williams turbofan jet engine sits right above the rear cabin occupant's heads. More on cabin noise in a minute.

The high aspect ratio carbon fiber wing structure houses the fuel bays (one in each wing) between the two spars. Each tank holds 148 usable gallons of Jet A. The ailerons and wing flaps are aluminum and all of the control system components including the aileron push rods and flap torque tubes are routed along the rear side of the aft spar. Carbon fiber wingtips with smart Whelan LED lights attach to the upper and lower wing skins.

The empennage consists of two large carbon fiber surfaces in a V-tail configuration, along with two ventral fins that have attach points for the aircraft's yaw stability augmentation system (Yaw SAS) flight surfaces.

There's also a yaw stability augmentation system that's controlled by the integrated autopilot's servo

On the ramp, the G2 Vision Jet has a 38.7-foot wingspan and stands 10.9 feet high. The Williams FJ33-5, middle, makes 1846 pounds of thrust and has FADEC with autothrottle. Notice the simple fuel selector arrangement, bottom.

motor. The control surface, which is hinged to the ventral fin, rotates asymmetrically to actively augment lateral and directional stability. The system shuts off when the autopilot yaw damper automatically engages above 200 feet. No wagging of the tail like other V-designs.

And when it comes to protecting the airframe from ice, the SF50 uses a variety of mostly conventional methods, unlike TKS fluid primarily used on the piston models. The wing and stabilizer leading edges have pneumatic deice boots, the engine inlet is protected by engine bleed air and integral electric heaters protect the pitot probes and AoA (angle of attack) vane. The windshield and radome are protected by TKS fluid and a reservoir holds three gallons of the slimy liquid. The ice protection system is smart and automated.

As an example, the wing and stabilizer pneumatic boots have three operating modes. When on, the controller automatically and continuously cycles the three deicer zones (stabilizer, lower wing and upper wing) for six seconds each, every 60 seconds. As you'd expect, even with this smart system, takeoff is prohibited with any frost, ice, snow or slush adhering to the wings, stabilizers or control surfaces,

And regarding the AoA vane—you might recall the FAA AD that was slapped on the Vision Jet last year because of faulty hardware that caused an uncommanded pitch change in some of the jets. That's been long resolved and Cirrus has replaced all of faulty vanes in the existing fleet.

HIGH-ALTITUDE EFFICIENCY

The first-gen Vision Jet was limited to 28,000 feet because it wasn't RVSM certified (reduced vertical separation minimums), but the G2 is RVSM compliant and now goes to 31,000 feet. Just that extra 3000 feet of altitude means you can either fly farther, or load the cabin with more passengers or stuff. Using NBAA IFR range minimums, a 1300-pound payload means you can fly the Vision Jet a touch over 1200 nautical miles at best economy, or 240 knots true. Push the speed to 300 knots true and you can still fly 1000 nautical miles.

Even with the higher altitude certification, the G2 has the same 8000-foot cabin altitude and the differential in the pressurization system is now 7.1 PSI, up from 6.4 PSI in the original Vision Jet.

Cirrus' Matt Bergwall said that the typical mission is around 800 miles with 950 pounds of payload. It's easy—go slower to fly farther.

Like the G1, the latest Vision Jet is powered by a Williams International FJ33-5A turbofan that produces 1846 pounds of thrust. The -5A engine was certified in June 2016 (the original FJ33 was certified in 2004) and Williams designed the engine series for light jets in the 5000- to 9000-pound GTOW class.

The engine, which has dual-channel FADEC (full authority digital engine control), sits atop of the airframe just aft of the passenger cabin and has a dry weight of 308 pounds and a 4000-hour TBO.

It's a whole other world in the high flight levels and for that the aircraft has some built-in failsafe. If there is a loss of cabin pressure when the pressure altitude is sensed

The Vision Jet has Garmin's G3000 Perspective Touch+ integrated avionics, including autopilot with electronic stability and protection, top photo. The sidestick, middle, makes for a roomy cockpit. That's the one-touch engine start control positioned forward of the stick. That's the autopilot console at the bottom.

to be above 14,900 feet, the EDM (emergency descent mode) in Garmin's integrated autopilot descends the aircraft to 14,000 feet at a speed reference that's 10 knots below the current structural speed limit and the autopilot holds it there. During the descent the EDM reduces engine thrust to idle. Once at a safe altitude, the EDM will bring the throttle back to N1, or 83 percent.

BETTER CABIN EXPERIENCE

The cabin can seat up to five adults and two children, and there are three different seating configurations available. The Executive version has wider seats in the number three and five seating position. There's the more traditional Family configuration, which has three cabin seats with two optional child seats for a total of seven (including pilot and copilot), while the Complete seat arrangement is a combination of executive and family seats, plus a center console with folding tray tables.

The fit and finish of the G2's interior just seems better. Cirrus upgraded the carpeting and added small conveniences that mean a lot, including kangaroo pouches in the front of each seat to hold a smartphone, and a side pouch to hold an iPad. The aircraft I flew also had a 22-inch drop-down LED monitor in the overhead for passenger entertainment. There's the expected USB ports, good cabin lighting, plus dedicated environmental controls for the rear cabin.

Up in the cockpit, Cirrus worked hard to ease transitions from the SR22 cockpit. I'm not going to say that flying the Vision Jet is like flying a big SR22 as some have because it just isn't. But if you have even limited experience in the Garmin Perspective-equipped SR22, the jet will be a familiar environment. The latest avionics is the Garmin Perspective+ G3000 suite, with PFD, MFD and three touch controllers.

To power and start the aircraft (the Vision Jet has a two-generator, two-battery 28-volt electrical system with a main, essential and emergency bus), there are two rechargeable True Blue Power lithium-ion batteries for starting and for emergency. The new batteries mean faster and cooler engine starts and a sizable weight savings.

The main reason SR pilots should feel at home in the Vision Jet's cockpit is because the battery and generator switches are in a familiar bolster panel on the pilot's subpanel. This row of rocker switches has been used in the SR since day one. I think Cirrus nailed the ergos in the jet just as they did in the pistons. Everything seems logically placed.

FLYING IT

Once in the seat and ready to fire the Williams, you run the integrated checklist on the Garmin MFD. Forget some of what you know about starting a turbine because the Vision Jet makes it foolproof and easier than ever. The engine has dual, software-controlled igniters that alternate with each successive engine start. Simply turn the engine start rotary knob to the Run position. That turns on the electric fuel boost pump. Press and release the Engine button in the middle of the

The Vision Jet's huge cabin windows make for a pretty comfortable passenger experience. It's also quieter and spacious, at 5.1 feet wide and 4.1 feet tall, middle image. Rear passengers have control over heat and air conditioning, bottom.

rotary knob and the FADEC does the rest—from commanding the ignition to scheduling the flow of fuel once there's sufficient N2 speed. The igniters shut off automatically when the computer senses a successful start.

But if there was an excessive rise in ITT (or if the Williams fails to ignite), the FADEC will automatically abort the start. Out of the chocks the Vision needs a blip of the power lever to get rolling and like the SR piston models it has a fully castering nosewheel. The nosegear strut is a conventional air/oil oleo shock/strut extending from a trunnion and has self-centering cams to lock the wheel straight when the strut is extended and the landing gear is retracted.

Lining up on Hartford Brainard Airport's Runway 20 in Connecticut on a hot day (ISA+15) with flaps set at 50 percent and the thrust lever in the takeoff position, the drill was to pitch for 5 degrees on the horizon, and the flight director command bars lead the way. Once rolling the 90-knot rotation speed doesn't come at lightning speed, but it's fast enough and loaded with three average-sized people and full fuel the jet was off in roughly 2500 feet. With a positive rate of climb and the gear in the wells, the airplane settled into a 1500-FPM climb. The yaw stability system automatically engages at 200 feet in the climb and the airplane is stable and reasonably pleasant to hand fly, although you'll want to use the electric trim. There are several centering springs that help with roll, pitch and yaw stability and you feel them when hand flying. Like the SR22/20, if you don't properly trim, especially at slow speeds, you will lose the battle to fairly heavy control pressures. The Vision has roll trim, via a dedicated servo motor, and it's easy to keep the airplane in trim.

The takeoff thrust setting is limited to five minutes maximum, and the POH advises to pull it back to the MCT (max continuous power) position within two minutes. "Engine life and maintenance costs are contingent upon observing the two-minute limit of takeoff thrust for every 72 minutes of flight," it goes on to say. The engine also has a deck-angle limitation and the book says to avoid a deck angle of 20 degrees or more for longer than 30 seconds. That's pretty steep and uncomfortable in initial climb.

Step-climbing to FL310, we were seeing 1500 FPM, but on cooler days the Vision will easily climb at 2000 FPM, which I've experienced on other flights. Once at our final stop at FL310 the Vision clocked in at 303 knots true, burning 60 GPH of Jet A.

There's no speedbrakes or spoiler on the Vision Jet, but it's easy to slow down with the 210-knot landing gear extension speed. You can even feed in the first notch (50 percent) of flaps at 190 knots. A thrust setting of 35 percent works for a 140-knot approach speed, and you make normal landings with full flaps. If you need to make a quick stop on the runway, don't look for a thrust reverser—it

VISION JET: THE SAFEST GA AIRPLANE?

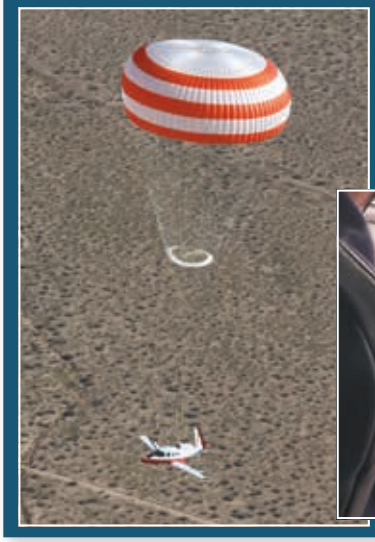
With under 150 Vision Jets in service since 2016, there are no wrecks yet. And with that it's far too early to declare the Cirrus jet the safest airplane, but based on its systems it's tough to argue that the airplane, on paper, isn't the safest equipped GA airplane in production—if ever. Let's look at the equipment that supports the argument, shall we?

Even with Garmin's Emergency Autoland (Cirrus Safe Return), the Vision Jet still has the CAPS whole-airplane parachute. A midair or engine failure over the mountains likely means a CAPS pull.

Some will argue that the Vision Jet is still a single-engine airplane, but that turbine planted on top of the cabin gives me far more confidence than any piston. The airplane has a bleed air pressurization system that sets itself based on flight plan field elevation, so pilots can't screw that up. If there was a failure, there's emergency descent mode, and if the pilot checks out, passengers can press the big red button in the cabin overhead and the jet will land itself.

Last, Cirrus' Matt Bergwall reminded me that Vision Jet pilots need to successfully complete the type rating training—an extensive course that's done in a Level D simulator and in the airplane. Put all that together and I think the G2 Vision Jet could be safest equipped GA airplane we've ever seen.

—Larry Anglisano



doesn't have one. But the airplane does, like the piston line, have excellent Beringer brakes and wheels.

AUTOTHROTTLE

A major new system in the G2 Vision Jet is Garmin's autothrottle. It trickles down from larger Garmin-equipped jets and is integral to the Safe Return Autoland, which flies a precision GPS approach to a full-stop landing at the best-suited airport, based on landing criteria, weather and other algorithms. It also has automatic braking and engine shutdown.

The autothrottle is activated with a button to the left of the thrust lever, while a thumb wheel is used to dial in the speed you want the autothrottle to maintain. Aside from Manual mode, it interfaces with the Perspective system's FMS via a mode selector button. The FMS is likely the most common mode because it follows the active flight plan, setting the precise speeds for all phases of flight.

As a real-world example, in the FMS profile the system can hold a climb speed of 155 knots (and the corresponding Mach number above 18,000 feet), an airspeed limit of 250 knots at 10,000 feet and a terminal speed limit of 200 knots for flying the airport environment. In cruise, the system keeps the speed off the barber pole, or the max operating Mach speed. For descent it will maintain 250 knots (or .52 Mach) and as you get closer to the airport it slows the airplane to 185 knots—a safe structural speed for dropping the flaps. With flaps at 100 percent, the autothrottle slows the airplane to 95 knots for the approach to landing.

Essentially what this automation means is with the autothrottle coupled with the FMS profile, you don't have to touch the thrust lever from the initial climb to 200 feet on the descent. The autothrottle also interacts with the Garmin autopilot's flight envelope protection system, guarding against underspeed and overspeed conditions. It's remarkably smooth and accurate, and just as tight when the Safe Return is flying.

I sat hands crossed while the Safe Return flawlessly flew the GPS approach and touchdown to the huge Runway 27 at Plattsburgh International Airport in New York.

YouTube **See a video of the Vision Jet flight trial at http://tinyurl.com/j95ht2a.**

CONCLUSION

I think the second-generation Vision Jet packs a huge punch for the $2.75 million (fully loaded) price tag. A lighter airframe (thanks mainly to the lighter batteries) and the ability to fly it just 3000 feet higher means it burns less fuel, you can carry more of it (roughly 150 pounds more) for more range on intermediate trips, or you can load the cabin with another person or more stuff. But, pilots aren't the only ones who will benefit from the G2's improvements.

During my time with the airplane I took off my headset and climbed into the rear cabin and was surprised at how well Cirrus reduced the cabin noise—it's a huge improvement over the old airplane. And overall improvement is a good way to describe the G2 Vision Jet.

With autothrottle, pending Safe Return emergency landing system and the ability to fly at FL310 it's tough to think Cirrus could make the Vision Jet better, but you can bet it's already working on it for the G3.

FLIGHT OPS

Missing Nav Data: So Long, VORs

It's no surprise the FAA plans to decommission them, but don't underestimate the impact it has on your navigation and the data that supports it.

by Frank Bowlin

Phase 1 of the FAA's plan to decommission over one-third of the nation's VORs will be complete later this year, by the end of September. Then, Phase 2 begins immediately to continue scrapping VORs at the rate of almost one a week.

While the chances are good (but not 100 percent) that your navigator's data is keeping up with the changes, you need to backstop it, which is easier said than done.

REPLACED BY GPS

Let's face it. VORs are obsolete, not just technologically, but operationally as well. When was the last time you used one to actually, you know, navigate? Even if you don't have one of those fancy GPS magic wonder boxes in your panel, you almost certainly have one on your lap and you use that for navigation. Fact is, we're just not using VOR navigation. If you're instrument rated, check back in your logbook. If you're like most of us, the last time you flew a VOR approach was on your last IPC, and the time before that was on the IPC before that. We just don't need VORs anymore … until we do (but we'll get back to that).

VOR ground station hardware—housed in those odd-looking, sombrero-shaped, white buildings in the middle of remote fields—is largely obsolete, with nearly 90 percent of them past their original 30-year expected lifespan. Since we don't use them anyway, and the hardware needs to be replaced, why bother? There's good argument to get rid of them, and that's what the FAA is doing.

In five years over one-third of VOR stations will be gone. This is muddying the avionics upgrade decision, and already causing grief with electronic nav databases.

The FAA knows we prefer to use simpler and quicker GPS navigation. But, they also know that GPS isn't quite as reliable as we might like, what with government agency after agency degrading or simply interfering with those fragile satellite signals. Depending on where you live, you might get multiple notices every few days that somebody's messing with GPS in your area.

Then there's the specter of a large-scale outage. This won't likely be for reasons of equipment failure, but is considered a real possibility from national disasters and/or deliberate interference from an outside actor. To accommodate the possibility of a large-scale GPS outage, the FAA has decided to reduce existing VORs down to a Minimum Operating Network (MON) of 585 VORs by 2025. Those remaining VORs will be sufficient to get you to an airport where you can land in good weather or use an approach not relying on GPS. Meanwhile, getting to a MON airspace means VORs are dropping left and right.

GONE, NOT FORGOTTEN

A number of things must happen when a VOR is decommissioned. Any associated airways, fixes and procedures must first be either redesigned or retired as well. Only then can the VOR itself be taken out of service. This involves adjusting the defining data to identify it as decommissioned while removing it from all the charts. Note that the VOR data entry isn't necessarily removed from the FAA database, but instead the status is changed to show that the navaid was decommissioned. That's a potential gotcha. And of course, this official FAA data is at the heart of the various data sources like Jeppesen, Garmin,

There's a potential for bigger issues that could affect all of the EFBs and even certified WAAS GPS navigators.

It's quite possible that some decommissioned VORs will remain in low-cost data sets for non-certified tablets and portables, top image. And even though a flight plan works in your portable, it might contain fixes no longer known to your certified navigator like Garmin's GTN 650, shown at the middle. Certified avionics like the WAAS-enabled Garmin GNS 430W use certified DO-200A data, bottom photo.

Seattle Avionics and others.

Certified, panel-mount avionics must use certified data. This data goes through rigorous quality assurance processing to ensure it is as error-free as possible before it is ever available to load into your navigator. While some vendors use similar quality assurance processes on data destined for non-certified EFBs, not all do, or their processes might leave possible errors undetected. It's inevitable errors like this that spawned this article.

As an example, but by no means to single it out, Garmin Pilot knits together multiple sources of nav data. First, of course, U.S. data originates with the FAA. But, Pilot also includes worldwide data from other sources. Not all data sources are of the same quality, and occasionally a VOR that was deleted from the U.S. data might still exist in data from another source and, as a result, it can get reintroduced into the complete nav data package used by Pilot.

We regularly fly a route from Santa Fe, New Mexico (KSAF), to Byron, California (C83), so rather than re-create this route every time, like many folks, we created a stored route to reuse. Within that route was the Manteca VOR (ECA) just east of Byron. In 2018, ECA was decommissioned and removed from FAA data.

Unfortunately, it remained in some other data sources with the result that it remained in the nav data used by Pilot. This meant that you could still flight plan using ECA in the underlying nav data, even though it was long gone from the charts.

Garmin did have a process in place to "blacklist" fixes like ECA, but it relied on fallible and not-necessarily-timely human input. After our inquiry about this, Garmin changed their data processing to prevent deleted fixes in the FAA data from being reintroduced to the entire data set from another source. We made inquiries about this with the other major EFB vendors. ForeFlight says it uses Jeppesen data that is rarely subject to these kinds of errors. Seattle Software also said their data is the same as is used for certified navigators, thus is mostly immune.

Hilton Software's WingX still, as of late November, shows ECA in the data and didn't respond to either of our two inquiries.

PROBLEMS CAUSED

There are a few implications from all this. First, let's take the case of the lingering ECA as we experienced. Because ECA still existed (as it still does in WingX) in the nav data, using a stored route with a fix like this is perfectly acceptable to the system; you'll never know there's a problem unless you carefully review the stored route on the charts and notice that the EFB placed a fix on the route that's gone from the charts.

So, you happily complete your flight planning and get ready to fly. When you try to put this route into

The route segment shown in the top screen grab of the Garmin Pilot iPad app still allowed the use of ECA as a nav fix, even after it was decommissioned and removed from the charts. More and more buyers are ditching ground-based VHF navigation and saving some upgrade money with Garmin's new GPS-only GNX-series navigators, bottom.

your navigator, though, an error should result. Also, since you probably filed the flight plan from that EFB, but with that obsolete fix, the flight plan was likely rejected. If you catch this error before calling for your clearance on the ground, the implications are minimal.

However, if you are in a hurry, like we were when we tripped over this, and you try to pick up a clearance on the go after departure, you might be in for a rude surprise requiring a good deal of scrambling to remedy.

But, there's a potential for bigger issues that could affect all the EFBs and even your certified navigator. Do you use stored routes? What will happen if the stored route has a fix that has since been deleted? Do you know?

The behavior of each system can be different, so analyzing that behavior of each EFB and each navigator is beyond what we could do. That means you should research this with your own devices. And, doing that research won't necessarily be easy unless you've already got a route with a decommissioned fix.

If you don't have such a route, you'll have to create one. But, based on what the EFB vendors told us, unless you're using WingX, it's likely you won't be able to create a route with a deleted fix, so you won't be able to store one.

If that's the case, you might have to dig though the manuals or contact the vendor for guidance.

Since this is an edge case, the behavior of your specific device might not be obvious when it encounters a fix on a stored route that isn't in the current data.

One would assume that the stored route merely stores the fixes and possibly airways, so the system won't recognize a deleted resource when you try to load the stored route. But, if the stored route also stores the nav data associated, there might be no way to detect this problem. Thus, it is incumbent on you to know the behavior in advance.

THE BOTTOM LINE

To review, there are two underlying problems that can crop up with fixes that have been deleted. 1) Even though the fix will surely be gone from the charts, the fix might erroneously remain in your underlying nav data and using it will be perfectly acceptable to the device when importing a stored route with that deleted fix. 2) The fix might indeed have been removed, but your device doesn't adequately detect that or warn you when importing a stored route containing that deleted fix. Note that both of these stem from the use of a stored route.

To minimize the likelihood you'll ever trip over this you could just avoid using stored routes, both in your EFB and in your navigator. But that's pretty drastic.

A better idea might be to carefully examine those stored routes as part of your planning, and deliberately verify each fix and each airway used on the route.

That verification should be done against current charts, as displayed on your EFB or your navigator if it displays all that, or even paper charts, if you still use any. This verification step has the added advantage of refamiliarizing yourself with the route. Along the way, you might even find something you want to change.

Last, of course, as we discussed above, know how your device behaves when it encounters an obsolete element in a stored route. With all these precautions, even with the FAA deleting almost one VOR a week, it's not likely you'll be calling for a clearance in flight, only to be told that there's no clearance available. At least, not for the reasons of you filing an obsolete fix.

Frank Bowlin is full of these "learn from my mistakes" little pearls of wisdom, which he shares even more readily as editor of sister publication, IFR Magazine.

AutoGyro's Cavalon, left is certified under the primary category. That means it can be flown under the sport pilot rule.

MARKET TRENDS

LSA Gyroplanes: FAA Warms to the Idea

Long relegated to kit-only status in the U.S., certified gyroplanes are available and will eventually achieve SLSA status.

by Paul Bertorelli

The autogyro is sometimes thought to be an American invention—who hasn't seen a black-and-white photo of the famed Pitcairn PCA-2?—but it actually originated in Spain. And it's Europe where this aircraft continues to thrive despite the fact that North America is still the largest and richest light aircraft market.

But persistence might be about to pay off. Sales of European-manufactured autogyros are rising modestly in the U.S. and the larger companies are applying new engine technology to make them even more attractive. Heretofore, most of these aircraft found their way to U.S. owners as experimental amateur builts. And while EABs are a growth industry in the U.S., autogyros just never caught the wave.

European-manufactured special light sport airplanes have found a toehold in the U.S. market, but autogyros don't fit into this niche, mainly because the FAA left them out of the SLSA definition and, until recently, none of the European models were type certificated. But EASA regulations do name a rotorcraft category in the microlight section and that's what makes it possible to buy and fly fully assembled autogyros in most European countries.

Rotax's 915 iS, below, was aimed at the gyroplane market and it appears to be finding some takers.

WORKING ON IT

As with electric airplanes, the exclusion of autogyros appears to be accidental. If it came up during discussion of the light sport aircraft and sport pilot rules, it got shuffled off and under the table. According to Dan Johnson of the Light Aircraft Manufacturers Association, that's about to change, although it will be awhile.

We spoke to Johnson at the Deland Sport Aviation Showcase and learned that the full, formal inclusion of autogyros as light sport aircraft is nearing approval by the FAA. And this is a good place to set the definition straight. In FAA speak, the proper term is gyroplane, not autogyro nor gyrocopter, which was once a registered trademark of Bensen. (It no longer appears to be.) Autogyro was also a registered mark of the Spanish inventor of the type, although it was spelled Autogiro. To further confuse the terminology, the largest manufacturer of this aircraft type is called AutoGyro.

But when the regulation appears, the official definition will be gyroplane. "The latest information is that it's absolutely still on the table for special light sport gyroplanes, meaning fully built gyroplanes. That's not been the way it's been for the last 15 years," Johnson says. "We're about as sure as you can be with any government regulation that's still in the works that this will happen," he adds.

Johnson says there may be strong underlying demand for gyroplanes because LAMA's data tracking shows increased sales, all of them in the EAB category. "So imagine what can happen when you don't have to go through that hoop-jump exercise," he says.

SWEEPING CHANGE

One overarching development injects a degree of uncertainty over not just gyroplanes, but the survival of light sport aircraft in general. It's the FAA's so-called MOSAIC regulatory reform. Encouraged by industry and the success of self-approval by light sport manufacturers, the FAA hopes to establish consensus standards for aircraft far less limited than the narrowly defined light sport category with its 1320-pound

weight limit. "That number is going away in the same regulation that will allow fully built gyroplanes. The FAA continues to say it won't be a weight in the future. It'll be a formula. They call it a power index," Johnson says. That means ASTM consensus standards could apply to aircraft up to 3000 pounds or more and possibly with four seats. "The FAA has come to love consensus standards," Johnson adds, "and wants to apply it to Part 23 airplanes."

What that means for the budding gyroplane market is unclear and it's no less muddy for fixed-wing LSAs. Would a heavier, four-place gyroplane excite more sales than a two-seat design? Who knows?

The more compelling question is when all of this is going to happen. It won't be exactly around the corner, but it won't be the end of the decade, either.

"There was a congressional mandate when the FAA was reauthorized. They put a time limit on things that needed to happen in order to get that authorization. So they've got to meet the deadline now and that's by the end of 2023," Johnson says.

That means the final rule has to be in place by then, so to allow for the glacial federal process, NPRMs will have to appear by late 2021 or early 2022 to make the cutoff.

While the new regulation will establish the broad-brush definitions and intent, it will be up to ASTM International to develop the line-by-line detailed standards. Johnson says that organization has traditionally worked quickly and is developing draft standards in parallel to the FAA's final rule.

SELF HELP

One company that didn't wait for the FAA's sclerotic action was the largest gyroplane manufacturer in Europe, Germany's AutoGyro GmbH. The company has a worldwide presence and in the U.S., its AutoGyro USA outlet has been selling kits and ready-to-fly aircraft and lately more of the latter.

One reason for this is that the company took the unusual—and expensive—step of certifying its products in the primary category, a certification path intended for aircraft used for personal or pleasure use. This means that the company's gyroplanes can be bought ready to fly and, according to Bob Snyder, of AutoGyro USA, because they meet the weight limits of the light sport aircraft, they can be flown by sport pilots. Or certificated pilots flying under light sport privileges. LAMA's Dan Johnson says this gives AutoGyro a sales advantage until the FAA finalizes approval of gyroplanes as SLSAs.

After that, we may see a flood of new entrants into the U.S. market. Or not. No one knows what the gyroplane market uptake will be.

But, says Snyder, sales are definitely increasing modestly, confirming what LAMA's data seems to indicate. "This year, we sold two experimentals. All of the others were type certified," Snyder said. That amounts to about a dozen aircraft. "Since the announcement of the 915, that's pretty much all we've sold," he adds, referring to the new Rotax 915 iS engine that is finding considerable traction in the gyroplane market. The 915 versions haven't been certified yet, but are expected to be within weeks. Snyder says the 915 in a AutoGyro Cavalon is a marriage made in heaven. "It is without a doubt the best flying gyroplane I have ever flown," he told us.

NEW ENTRIES

At the Deland show, we saw another new entry from a company called Airgyro. It's similarly equipped with a 915 iS, but is available only as an EAB offering, although LSA is planned. As with fixed-wing aircraft, the higher power—135 HP continuous for the 915 iS—increases climb performance dramatically, but doesn't do much for cruise. Snyder says the 915 iS-equipped Cavalon climbs at a blistering 2000 FPM. Snyder says a well-equipped Cavalon retails for about $160,000. Curiously, the EAB version is not much less, according to Snyder, if the builder utilizes the company's builder assist program.

At Deland's Sport Showcase, Airgyro was showing off a new model called the AG-915. It's currently limited to EAB in the U.S. but the company wants to market it as a light sport aircraft.

Light sport approval for gyroplanes might not make much difference to AutoGyro, since the primary certification it has pursued removes the barrier to purchase for many buyers. As for training, gyroplanes aren't difficult to fly, but one corner of the flight envelope can be catastrophic if not understood by the pilot. Lift comes entirely from the rotating rotor disc. It's powered not by the engine, but by the energy of the relative wind. Negative G maneuvering can steal the rotational energy and put the aircraft into an unrecoverable departure.

Gyroplane privileges require an add-on category rating, whether under the sport pilot rule or a higher certificate. How long does that take?

"It really depends on the person. I have had 10,000-hour corporate jet pilots take 35 or 40 hours. They come from a different environment of looking at the panel and probably never looking out the window," Snyder says. "But a gyroplane, like a Cub, is big-time, seat-of-the-pants, look out the window and fly it," he adds. Stick-and-rudder taildragger pilots usually adapt quickly.

"So what I tell everybody is to expect a minimum of 10 hours. There are guys that get it in just a few hours. Most of them are professional pilots," says. Average? Somewhere between 10 and 15 hours. "I haven't found anyone that I haven't been able to teach," Snyder says.

Faro Stealth 2 ANR: Mid-Priced, Oversized

With large ear cups, the latest $449 Faro is anything but stealthy. It's well-made, well-supported and has a smart control set. Fit it before you buy it.

by Larry Anglisano

CHECKLIST

- Generous features including USB-C power input and Bluetooth muting controls.
- The set seems durable and the control module is nicely engineered.
- Head clamping forces are moderate and this headset might be too large for small heads.

Nevada-based Faro Aviation has come on strong the past few years in the competitive headset market with a diverse model lineup. The latest Stealth 2, which is sold exclusively through Sporty's, comes in two price points. There's the $249.95 passive version and also the $449.95 ANR model with wireless Bluetooth, which is what we tried for the latest in our series of headset field reports.

We think the price is fair and the set has smart features, but its thick ear seals may be a tough fit for smaller heads.

FIT, BUILD QUALITY

Think of the Stealth 2 as a more traditional aviation headset with its adjustable metal headband. It has double-thick ear seals (1 inch thick) which makes the set seem larger than it actually is. Still, Faro managed to keep the set's weight (16 ounces) in line with others in its class—mainly the Lightspeed Sierra and Sigtronics S-AR.

Given the mass of those ear seals, fitting the set is important and you start by loosening the thumb knobs on headband's rails. Once you have the set on your head you adjust the clamping pressure by simply moving the cups up or down, and also fitting the seals so they're completely over the ear. And unless you were born with huge ears, that should be easy given the size of the seals. Once you find the right fit, crank down the thumb knobs.

In our evaluation, every pilot and passenger who tried the Stealth 2 initially commented about the clamping pressure—which if you're used to wearing a Bose A20 or Lightspeed Zulu 3 will seem high. We try hard to not compare low- and mid-priced headsets to these flagship models—which are obviously priced considerably higher. But on the other hand, we think Bose and Lightspeed set a standard for which any aviation headset is judged these days and it's impossible to not make comparisons for fit and performance.

We like that the set's electret microphone can be placed on either earcup, and that it has 360 degrees of rotation. Even better is that it's easy to position the flexible boom so the microphone is just where you want it in proximity to the lips, which should be roughly 1/8 inch away. There's nothing worse than a mic boom that has too much slop for it to precisely stay in place. That's not the case with this one—Faro got it right.

POWER OPTIONS, CONTROL MODULE

The Stealth 2 is powered by two AA alkaline batteries and the set has a 40-hour battery endurance. That's good, but keep in mind that operating the set's Bluetooth function will shorten battery life, as will the level of noise reduction that's required in a given cabin. The batteries are loaded under a removable door inside the set's control module.

Our evaluators say the 16-ounce Stealth 2 has moderate head clamping forces, but the set is eyeglasses friendly.

The battery compartment also houses two dip switches. One switches the set from stereo to mono and the other controls the auto shutoff. When it's enabled, the headset automatically powers off five minutes after the set is removed from the audio jacks or five minutes after the intercom is powered down. If for some reason the Bluetooth is left on (or the wired auxiliary input is active), the set powers off after one hour.

With panel USB power modules (and portable power banks) fairly common these days we like that the Stealth 2 has a USB-C power input port. It's located on the side of the control module and bypasses the battery power. The set comes with a USB-C power cable as standard.

We're generally critical of any headset's control module and we give the Stealth's controller high marks. It seems the right size and the buttons and switches have a durable feel, but we wished the mic and phone plugs were longer. They extend roughly 12 inches from the top of the module—which seems like enough length—but for audio jacks that are tucked deep under the panel, they may be too short.

One of our test aircraft has a portable intercom Velcro'd to the floor and the audio cables barely reached the jacks, leaving the module awkwardly suspended between the intercom and the front corner of the seat. Another 6 or so inches could be enough. We also wish all headset manufacturers would follow the lead of Lightspeed and wrap the audio cables in a braided sheathing. The ones on the Faro are thin, and we wonder how they'll hold up to long-term abuse.

The top of the module's face has thumb controls for independent adjustment of each earphone and the volume pots seem linear throughout the travel. Below the volume knobs is a power status annunciator. It flashes green when the battery power is strong, it flashes amber when it's low and flashes red when the voltage is very low. We like having the warnings, especially after not using the set for a while where you might guess how much life remains in the AA batteries.

Turn the set's ANR circuitry on and off (hold it for one second) with a round power button in the center of the module, and turn the Bluetooth on and off with a square button below it. A Bluetooth status annunciator flashes blue and red when the set is in pairing mode and it flashes red (twice) when it disconnects. The initial pairing with three vintages of Apple iPhones was easy, and the set connected the first time within a few seconds.

While large overall, the Stealth 2 has a rugged build and thick ear seals, top. The set's control model, bottom, seems the right size, but we wish it had longer audio cables.

And when using the Bluetooth you have the option of setting the audio priority. This means you can mute the Bluetooth audio when transmitting or receiving radio transmissions. Whet the switch is set to the airplane icon the set detects transmissions and significantly lowers the volume of the Bluetooth source.

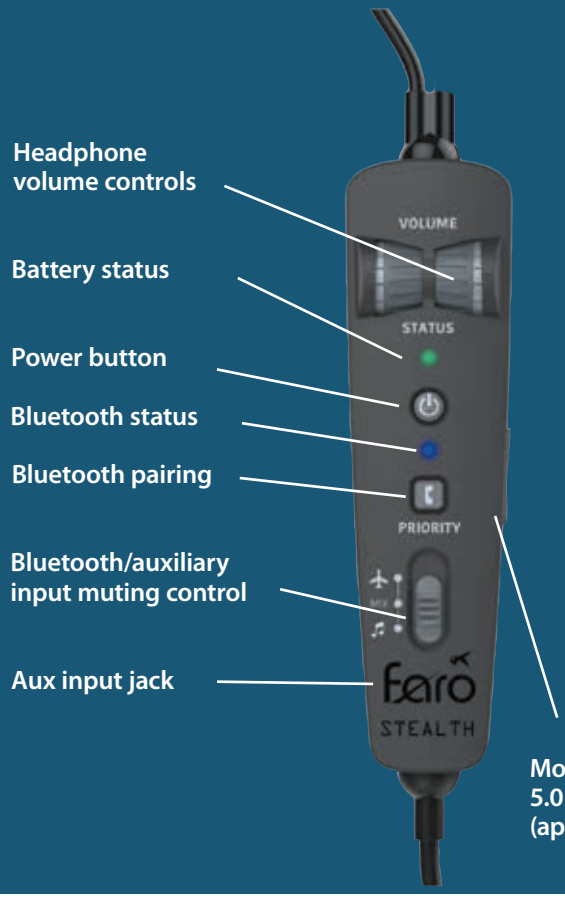
When the switch is in the musical note position the Bluetooth audio (and the auxiliary wired input, which is a 1/8-inch audio jack on the side of the module) will continue to play when the radios are receiving or when you are transmitting. You can permanently stifle the Bluetooth and auxiliary audio when the switch is in the off position.

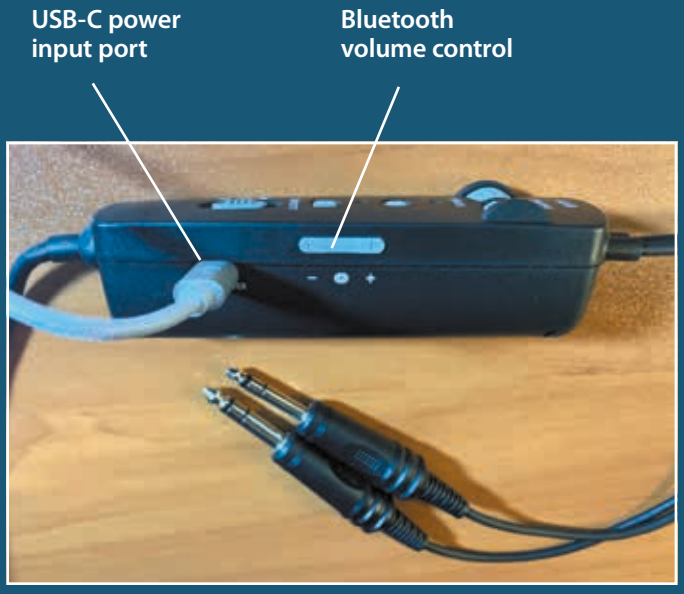
Faro did the right thing by putting a dedicated volume control for the Bluetooth and auxiliary audio input on the side of the module. It's nicely positioned for quickly lowering the volume when you need to.

WEARING THEM

We'll cut to the chase and say up front the Stealth 2 is a big set. It not a headset for small children and might be the wrong choice even for adults with petite faces. The ear cups do have a good range of adjustments for getting the right fit and there's sufficient padding where the top of the frame meets the head. If you're accustomed to flagship models from Bose and Lightspeed you might find the Stealth 2 to have far more clamping pressure. It helps that the ear seals are soft, but they are wide-reaching on small faces. We evaluated the set during the

FARO STEALTH 2 CONTROL SET



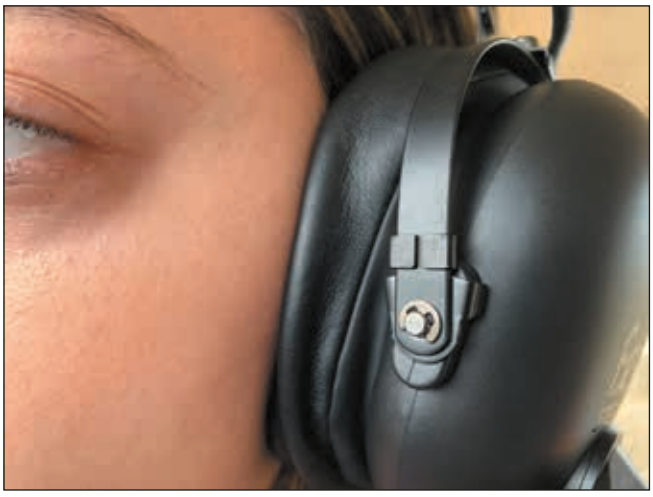


winter, so we couldn't see how much sweat they might generate against the skin. Eyeglasses seem to fit fine, thanks to the soft and well-cushioned ear pads.

As for ANR performance, the Faro's circuitry did well. In a noisy cabin at takeoff power we only slightly heard the signature rumble of the ANR circuitry overdriving as it tried to compensate. We brought along a Bose A20, a Lightspeed Sierra and a David Clark One-X for comparison and the ANR circuitry in all of them outperformed the Faro.

To be fair, these are models priced higher (the Bose is more than twice the price), but they're worth using as a benchmark comparison.

As for audio quality, we think the Stealth 2 is acceptable. It won't win any awards for high-fidelity sound, in our view. The stereo Bluetooth audio was, like the radio/intercom quality, acceptable but we've heard better. Again, given the set's $450 price point we're not complaining. Just don't expect to be blown away with exceptional audio quality.



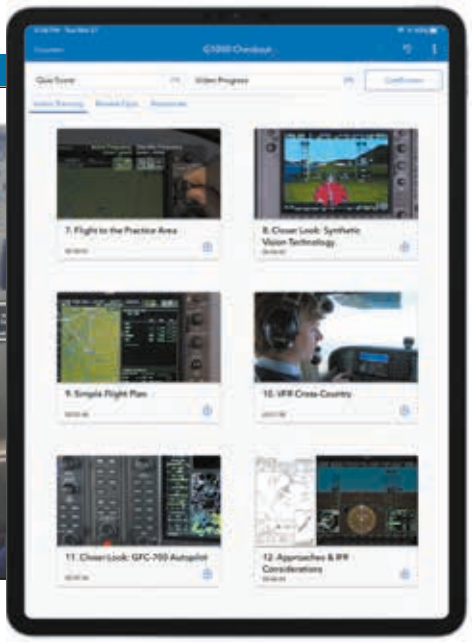
The one-inch-thick ear seals are soft and comfy against the skin, but they'll dominate smaller faces.

The microphone audio is quite good when we sampled it through a variety of intercoms—both vintage portable units and the latest panel-mounted units from PS Engineering and Garmin. It never clipped and modulation was crisp and accurate. Again, it's easy to position the bendable boom to place the mic right where you want it.

A GOOD VALUE

That's how we summarize the Faro Stealth 2 ANR, particularly for buyers (especially students) looking for a generously equipped set that won't break the bank. We're tempted to ding it for its large size, but it seems those fat ear seals contribute to decent performance. Our age-old advice for headsets still stands: Try it before you buy it.

Visit www.faroaviation.com and buy it exclusively from Sporty's, at www.sportys.com.



G1000 e-Study Aids: Jepp, FlightSafety Tops

For transitioning to Garmin's G1000 avionics or freshening up the knowledge base, we selected a handful of electronic courses that can help.

by Kate O'Connor

In the July 2019 *Aviation Consumer* I rounded up the top electronic study courses for earning the private pilot certificate. But since some of the initial or advanced training might be accomplished in a Garmin G1000-equipped airplane, for this article I went on the hunt for the top electronic supplemental study aids to ease the learning curve.

And even if you're a seasoned pilot making the transition to a G1000 from traditional flight instruments and stack-mounted radios there will still be a lot to learn. Here's a market scan of the most comprehensive electronic study aids focused on the G1000 system.

JEPPESEN

Jeppesen's Garmin G1000 VFR & IFR Procedures courses are scenario-based, interactive courses. The courses use an interactive G1000 simulator to guide the student through real-world scenarios for using the system. The VFR and IFR courses are offered separately or as a bundle. Both use the same format, which organizes sections by phase of flight. Each section is then broken down into a series of lessons and tasks to be completed on the simulator. The simulator mimics a typical G1000 setup in a Diamond DA40—the first airplane with the G1000 on its type certificate.

Lessons include a demonstration section, which explains the system features and tasks and provides a visual walk-through on the simulator. For most lessons, the student can then click to a Train page. In Train, directions are provided for the completion of the listed task. A Solo page is also available, which has the student perform the directed task without assistance. Incorrect actions are flagged and lesson credit is awarded for completing Solo tasks with an acceptable number of errors. Lessons can be viewed in any order and the course reopens on the last completed lesson. A progress tracker lists what percentage of the course has been completed.

The VFR course covers operations from startup through arrival. It also offers sections on autopilot and abnormal and emergency operations. Lessons are available on TIS, TAWS and G1000 weather. The IFR course covers departure, enroute, WAAS and approach scenarios. Both courses have sections on common mistakes and tips for using the G1000.

Each course ends with a 20-question exam. Questions can be marked for follow-up and answers can be reviewed with attached explanations after the exam. A passing score for the exams is 80 percent. Exams can be retaken and questions vary with each attempt.

After taking the courses, I think Jeppesen's Garmin G1000 VFR & IFR Procedures are a great resource for pilots looking for a hands-on way to familiarize themselves with the system before getting into the airplane, and equally as good for reviewing once you've gained some experience. The procedure-based training provides good practice for real-world scenarios and the lessons are clear and well-presented. While not flawless, the Jeppesen G1000 simulator is very good. It accurately mimics the G1000 system and gives pilots a chance to get some hands-on time with the equipment before trying it out in the airplane.

If I had a nit to pick it would be

The Sporty's G1000 Checkout Course, top, uses a Cessna Nav III aircraft for VFR and IFR study.

Jeppesen's G1000 VFR & IFR Procedures courses center around the Diamond DA40, top, and take the user from startup to shutdown.

that the courses could be improved by making it easier to identify completed lessons, but that's minor.

The bigger issue is that Jeppesen's courses do not support tablet use. The VFR procedures course is $119.96, and the price for the IFR procedures course is $109.96. Bundled together, the VFR & IFR Procedures courses are $199.96.

FLIGHTSAFETY G1000 FOR KING AIR 200/300

FlightSafety International's Garmin G1000 for King Air 200/300 Series eLearning course is also an interactive, situation-based program. As the title implies, the course is designed to cover G1000 features and functions as installed in the King Air 200/300 series—a popular retrofit for these airplanes. The course includes VFR and IFR operations and the course duration is approximately 11 to 13 hours.

The course is organized into 19 modules plus a course introduction. Mandatory sections are marked on the course menu as are completed modules and sections. Each module is divided into sections, which are organized by topic. Each lesson includes audio explanations with associated visual demonstration. Modules can be completed in any order, but all mandatory sections must be completed to finish the course.

Periodically throughout the modules, the student will be asked to complete a task on the interactive G1000 simulator. These start with a task demonstration followed by guided walk-through practice sessions, called Try it. Once Try it has been successfully completed, a knowledge evaluation has the student perform the task without hints. Check Your Understanding (CYU) sections also appear in the modules. CYU question options include multiple choice, matching and system control identification.

Modules cover topics including situational awareness, the synthetic vision system, emergency and abnormal procedures, and G1000 hazard avoidance tools like the Traffic Information System (TIS), Terrain Awareness and Warning System (TAWS) and GDL 69A XM Satellite Weather. The last module is a Final Scenario during which the student must perform a series of procedures in a real-world scenario beginning at startup and ending with reloading an approach after a missed approach. There is no demo provided for Final Scenario tasks.

The course provides a glossary where terms can be looked up alphabetically or searched for. A notepad function is available where notes can be taken for the overall course or specifically for any page of the course. Notes can also be copied and saved on the computer and/or printed. A Help button provides a Course Quick Tour option and allows students to email learning procedure or system operation questions to a learning management system administrator. An Email button lets students email questions to a subject matter expert. And a Bookmark option lets students bookmark a screen. All audio is closed captioned with a transcript box provided. The entire course is also searchable. Additional course resources include PDF files on updating Garmin and Jeppesen databases, the traffic advisory system and activating XM services.

FlightSafety International's Garmin G1000 for King Air 200/300 Series eLearning course offers a thorough, in-depth and well-developed program. The regular use of interactive components and what are essentially G1000 simulator lessons is highly effective and creates a top-of-the-line learning experience. As a side note, the course also pays good attention to how its 2D representations might differ in appearance from the actual equipment including showing multiple-viewpoint images for better real-life identification.

The course interface is complex, but a good introductory module/course tour successfully explains the graphic user interface, course navigation and interaction with the course's simulated environment. One minor drawback is that it is not designed for use on mobile devices. Our only significant issue with this course is the price, which comes in at $620 for one year access.

SPORTY'S G1000 CHECKOUT

The Sporty's Garmin G1000 Checkout course is made up of 17 video

lessons that review both VFR and IFR scenarios. The course primarily uses Cessna Nav III aircraft to demonstrate and the lessons are organized by topic. In addition to introducing the basics of the G1000, the course offers two good cross-country walkthroughs—one for VFR and one for IFR—along with lessons on emergencies and possible variations in G1000 systems. Total runtime for all of the videos is a little over two hours. They can be viewed in any order.

The course concludes with a 35-question final review quiz. Answers can be reviewed after the quiz is graded and the quiz can be retaken as often as desired. Questions are selected at random from a question bank and will vary each time the quiz is taken. A course completion bar tracks course progress and a progress report logs review quiz scores and answers.

Additional resources provided as part of the course include a G1000 syllabus and instructor guide. The lesson breakdown in the syllabus and guide includes completion standards and lists of common errors, which provide good add-on information and further framework for the course. A Cessna Nav III cockpit reference guide, which can be downloaded or viewed online, is also part of the package.

The Sporty's Garmin G1000 Checkout course is compact, well-organized and offers great, informative HD videos. The Closer Look lessons, which cover specific features in greater detail, are a standout addition to the course. Closer Look topics include weather resources, checklists and charts, synthetic vision, Garmin Connext and GFC 700 autopilot. Course navigation is straightforward and easy to use. The course could be improved with more regular assessments throughout the course and interactive features.

In addition to computer access, the course can be taken on the Sporty's Pilot Training app for both iOS and Android systems, AppleTV and RokuTV. Course progress will sync between devices. A course completion certificate is available once video training has been completed and a review quiz passed with a score of 80 percent or better. Cost for the course is $99.99 for lifetime access. It is accepted for FAA WINGS credit.

KING SCHOOLS FLYING THE GARMIN G1000

The King Schools Flying the Garmin G1000 course comprises 12 labs, each of which includes a series of video lessons ranging in length from a couple of minutes to over twenty. The course covers both VFR and IFR operations with the G1000 and the labs are organized by topic and type of flight. The King course does not take an aircraft-specific approach, instead pointing out that students should take time to familiarize themselves with the exact system they will be using. There are seven hours of video lessons in total, which can be viewed in any order.

Overall, the course is a very good introduction (or refresher) to using the G1000 during both VFR and IFR operations. The videos are engaging, well-paced and easy to understand. There are some particularly good discussions of how to transition from round gauges to glass. It goes beyond the basics to cover a lot of G1000 features and options like how to use the Garmin GFC 700 autopilot, WAAS, XM weather, Terrain Awareness and Warning System, Traffic Information System, SafeTaxi, FlightCharts and G1000 checklists. It offers separate labs for how to handle G1000 failures in VMC and IMC, which we felt was an important and well-handled distinction. It's easy to see which labs have been completed and to navigate to different areas of the course. The course could be improved by providing some kind of assessment tool for users. It's video-only and does not offer any interactive features, quizzes or tests.

That's a section in the FlightSafety International G1000 for King Air course covering raw navigation duties.

The course can be accessed via computer or on iOS devices using the King Schools Companion app and course progress will sync between devices. The app allows users to download the course for offline viewing. A completion certificate is available once all of the labs have been completed and it is accepted for FAA WINGS credit. Cost for the course is $179 for lifetime access.

VIRTUAL POH GARMIN G1000 ONLINE TRAINING

The Garmin G1000 Online Training system from Virtual POH is an interactive G1000 demonstrator coupled with audio briefings. The course provides visual demonstrations on a virtual G1000 to go along with the audio lessons, which are organized by topic and separated into PFD and MFD briefings. The interactive demonstrator allows students to both follow along during demonstrations and reproduce system tasks.

The course is VFR-focused and not aircraft specific. There are about three hours' worth of audio content,

G1000 SIM TRAINING: REALITY CHECK

While I've flown G1000-equipped aircraft, I'm fairly sure the amount of time I've spent in G1000-equipped simulators far outstrips the time I've spent in the air with the system at this point. My first introduction to the G1000 was in a Cessna 172-configured sim. Being the somewhat obsessive student I was, I studied the then-new G1000 before that first sim flight pretty extensively. I arrived having memorized a good chunk of the manual and could point to components, name LRUs and so on.

I quickly discovered that while my studying was certainly useful, it did very little to prevent me getting seriously confused and behind in the sim when flying the airplane had to happen at the same time as pushing all of those buttons. I'll never forget just how overwhelming it was to go from feeling like I had everything pretty well handled on a 172 with a standard six-pack to being sure I had no idea where to look or what to do next. I followed the Cessna sim up with a Piper configuration and a King Air setup and using the G1000 eventually became second nature.

Working on this e-study G1000 course review was a good reminder of those days. It meant I had put myself in your shoes by thinking back and walking myself through which pieces of information were most useful when I knew nothing about the system, and which parts of my training didn't work so well. Looking at it that way, my primary takeaway is that an interactive environment is invaluable when it comes to learning the G1000.

Being able to bring that kind of training home, at least in part, is a great resource and one that's only served by a sim. We'll look at simulator-based avionics ground courses for retrofit and OEM glass in a separate article.

—Kate O'Connor

but the demonstrator can be used separately. Hovering the mouse over a demonstrator button or knob will pull up a short description of its function. Briefings include general and page-specific system operations along with traffic, weather and terrain awareness capabilities. An XM radio briefing is included.

In general, the course is simple, but effective. It is geared toward beginner students who are not familiar with the G1000 system. It covers some good basics such as how to clean the screens and maintain the system that we didn't see in other programs. This was the only course we reviewed where the interactive component could be used freely, which is a great benefit to learning the system.

While a good resource for students working to get a handle on the basics, this program is not particularly designed for pilots looking to develop a complete understanding of the G1000's capabilities. The demonstrator is not a fully functioning representation of a G1000 and there are some tasks it can't perform. There are no progress trackers and the course does not cover abnormal and emergency operations.

Course navigation is trouble-free and the demonstrator functions smoothly and intuitively. The course runs $99 for 12 months. It is iPad compatible.

PILOT LEARNING GARMIN G1000 VFR AND IFR

The Pilot Learning Garmin G1000 VFR and IFR (non-WAAS) courses are designed and presented by 2008 National CFI of the Year Max Trescott. Both courses are divided into sections and each section includes a series of video lessons. The lessons—51 for VFR and 40 for IFR—are organized by topic and do not focus on a particular aircraft model.

Videos average between five and fifteen minutes. Short scenarios are periodically included in lessons to cover related G1000 tasks. Lessons can be viewed in any order and are marked once completed. A course progress tracker appears at the end of each section and a counter displays the number of lessons completed.

Beyond standard use of the G1000 system, the VFR course includes lessons on G1000 terminology, traffic, weather and terrain along with G1000 checklists, autopilot interaction and malfunctions. It also reviews the advantages and disadvantages of a glass cockpit system compared to round gauges. The VFR course ends with a video following typical G1000 use on a Cessna 172 flight from preflight preparation to shutdown. In addition to covering G1000 use for IFR departure, enroute, arrival and approach procedures, the IFR course has lessons on glass cockpit instrument scans, holding, flying a DME arc and using OBS mode. Additional features include a searchable glossary (VFR) and weekly progress reminder emails for active courses.

Overall, Pilot Learning's Garmin G1000 VFR and IFR (non-WAAS) courses provide a solid, well-delivered introduction to the system. Video lessons are clear, concise and organized into easily watchable lessons. There is good focus on system limitations and common areas where pilots get stuck with the

G1000. Course navigation is clean and simple, although the courses could be improved by providing assessment tools.

The courses are designed for viewing on a computer but can be accessed via mobile devices with an internet connection. The Garmin G1000 VFR course and Garmin G1000 IFR (non-WAAS) course cost $59 each. A separate Flying WAAS and GPS Approaches course is offered for $79. Monthly and yearly membership options are available, which include access to all three courses during the specified time period. Membership fees are $29.95 per month or $299 per year.

GOLD SEAL

The Gold Seal Online Ground School has the Garmin G1000 Checkout course, which is VFR-focused and interactive. The cost is $47 for one year access. We didn't cover it in detail here because the company asked to not participate in our roundup. If you have experience with this course we want to hear about it. For now we can't recommend it.

TOP PICKS

For G1000 courses, we have a strong preference for the interactive editions. Selecting the best of those was no easy task. FlightSafety International's Garmin G1000 for King Air 200/300 Series eLearning course offered the most thorough program coupled with an effective watch-try-do teaching method and a tidy, bug-free G1000 simulator.

It also provides the widest array of helpful features. It's a worthy course geared toward professional pilots, but the price (and King Air focus) puts it in a separate category from the rest.

If you plan to transition to a G1000 King Air, we think it's a must-have study course.

For those looking for a G1000 learning experience geared more toward single-engine piston general aviation flying, Jeppesen's Garmin G1000 VFR & IFR Procedures courses are our top pick.

The interactive lessons use a similar—and highly successful—watch-try-do format and there's great depth to all of the topics presented.

THE CIRRUS APPROACH

I'll admit it. If Cirrus' Cliff Allen wasn't sitting shotgun and backstopping my every move on a trip in a new SR22T with Garmin's Perspective+ G1000 avionics, I'd still be on the ground fumbling with entering the flight plan in the system's FMS. "Mastering the Garmin Perspective avionics in later SR20/22 models won't happen in a five-hour checkout," Allen warns. He's right. Consider that Cirrus corporate pilots—no matter the ratings or flight experience—are restricted to 500 feet above published minimums on approaches under IFR for the first 100 hours in type. If that doesn't speak volumes for the level of automation and complexity in these airplanes I don't know what does.

For Cirrus, it's all about the training, and it has plenty of good materials. For starters, the Interactive Flight Operations Manual (iFOM) is an iBook summary of how Cirrus prescribes operating the aircraft. Additionally, an integral part of transitioning to a Cirrus with a G1000 Perspective series includes the Cirrus Approach study modules. Cirrus Approach covers nearly all aspects of operating the airplane and is a library of Vimeo-based video presentations led by Anthony Bottini, a Cirrus Standardized Instructor Pilot. Among the other aircraft systems covered, there are two in-depth avionics courses.

The launching point for a Cirrus Perspective+ transition (the current G1000 in Cirrus SR20/22 models) is the SR2X Perspective+ Transition avionics training course. Bundled with the Perspective and Perspective+ Avionics, Takeoff and Landing and Engine Management courses, the Perspective Transition course in instructor led, and is really intended for non-instrument rated pilots new to flying a Cirrus. The estimated lesson time is 3.5 hours, and it took me a bit longer because I made particular note of areas that trick me up when I fly the airplane. The Perspective+ Transition course summarizes everything from cockpit layout and remote sensors to flying the system in the real world. It's incredibly detailed and taught in plain language, with excellent supporting B-roll and graphics.

The other procedure-focused program is the Perspective and Perspective+ Avionics Course. Its fundamental goal is to present transitioning pilots the proper procedures to build their overall knowledge and confidence to fly with the Garmin system under VFR or IFR. The typical completion time is around three hours

There is a long list of items covered, broken down into video segments. It starts with the components that make up the system, the PFD, MFD, FMS, AFCS (autopilot), audio system, standby instruments, database updates, Flight Stream 510 wireless cockpit system, plus normal operations and abnormalities and reversions.

"We can't teach pilots everything about transitioning to the Perspective and Perspective+ avionics, but we ensure they have a solid pathway to walk away from the flight training confident enough to get the airplane home, and then learn more," said Brad DeGusseme, the company's Learning Content Manager. The avionics courses are $200 each, and are included in a new Cirrus purchase.

—Larry Anglisano

Advanced Preflight After Maintenance

The NTSB believes that a significant number of post-maintenance fatal wrecks might be avoided if pilots got serious about preflighting.

by Larry Anglisano

If you've ever retrieved an aircraft from a maintenance shop you probably sat up a little straighter in the seat on that first takeoff run. If you haven't, your mind is not in the right place.

Maintenance can—as the NTSB reports consistently prove—introduce another layer of risk that goes with the territory of wrenching an aircraft. Whether it's infant mortality of replaced components or improper installation and reassembly, face the fact that the chances of a mechanical problem might be considerably higher after a maintenance event.

There are some things you can do to help minimize the risk, and it starts long before you fetch the aircraft from the shop. The agency's FAA Safety Team (FAAST), with guidance from the NTSB and the General Aviation Joint Steering Committee (GAJSC), have issued a fact sheet pertaining to the subject of advanced preflight practices following aircraft maintenance that I think every pilot should read. A lot of it is common sense items, but I bet the majority of pilots don't give the topic the thought it deserves.

The fact sheet reminds us that it's the PIC who is responsible for determining whether the aircraft is in a condition for safe flight per 14 CFR 91.7, and that also includes making sure the paperwork trail (14 CFR 91.405) is in place that says the aircraft has been approved for return to service. This is an important signoff that often gets dropped out of haste. Or maybe the customer retrieves the aircraft when the shop is closed, and the maintenance release never got issued. I once dealt with an off-field landing after maintenance and the first thing the FAA wanted to see was the maintenance release.

COMMUNICATE, AVIATE

These days it's easier than ever to communicate with the people who work on your aircraft. Ask the shop for simple progress reports as it completes major tasks on the aircraft. This way you'll already be anticipating the first flight after maintenance, with a solid plan ready should something go wrong. It pays to periodically visit the shop while the aircraft is torn open so you have a firsthand glimpse of what the shop is doing. That's also a good time to have a sit-down with the people working on the aircraft so you can learn, in detail, about issues that were found during inspection or repair and alteration. This also includes avionics retrofits and even interior work.

Before the first flight after maintenance ask the shop what to look for when you get the airplane on the runway. And before you even climb in, backstop the tech who signed it off by making sure all inspection plates are on and secure and check for correct and unimpeded flight control surface deflections. Look carefully into the engine bay. Do you see any oil leakage? Smell raw fuel in the cabin? I climbed in a Baron once after an avionics job and smelled fuel, yet made the mistake of launching only to find fuel leaking from a loose fitting on the fuel flow gauge.

If the interior was removed (at least the front seats are almost always removed after major work), put your eyes and fingers on the seat stops. These keep the seat from sliding back on the rails uncommanded and sloppy shops and preflighters sometimes miss them. Check the pitot and static ports for remaining tape (especially after a pitot/static inspection). If you rent, conduct this level of preflight all the time and look closely at the squawk sheet.

Last, take care of billing matters before showing up to retrieve the aircraft. This part of the job is a huge distraction, especially if there's conflict over what was billed, and carries over to the cockpit where you need to be focused.

There's more in the fact sheet found at https://tinyurl.com/rm3qtte. It's worth reading, saving and fine-tuning to suit your operations.

Play an active role in the maintenance of your aircraft by knowing what was accomplished before flying it away. The risk is higher with complex machines. That's a Husky on amphib floats at the left.

FAA AD For Bonanzas: Failing Control Cables

A swath of the Bonanza fleet must be inspected for fractured aileron control cables. Worst-case costs including parts and labor could reach $3000.

by Larry Anglisano

The FAA is adopting a new airworthiness directive (AD 2019-21-08) for a wide variety of Beech Bonanza and Debonair models to address field reports of cracked and fractured right aileron flight control cable end fittings. The range of models includes the E33, E33A, E33C, F33, G33, 35–C33, 35–C33A, K35, M35, N35, P35, S35, V35, V35A, 36, and certain models of the F33A, F33C, V35B and A36 airplanes. This AD requires inspecting the right aileron flight control cable end fittings (terminal attachment fittings) and replacing any damaged cable assembly.

At press time, the FAA received roughly 17 reports of the right aileron control cable end fittings failing on E33A, S35, V35 and A36 Bonanza models. The FAA estimates that the AD affects 4138 airplanes on the registry, while inspection is the only way to determine which ones require replacement hardware.

There are two different cable assemblies installed on the right aileron flight control system. The forward aileron cable assembly connects the control wheel to the turnbuckle, and the aft aileron cable assembly connects the aileron surface to the turnbuckle. These failures have occurred at the swaged cable end fittings that thread into the turnbuckle. According to the supplemental discussion in the FAA's final rule and request for comments, the location of the cable seems to play a role in the hardware's failure and it's all about corrosion.

The location of the right aileron cabled fittings, just forward of the aft carry through spar and underneath a heating duct, creates an environment where corrosion may be accelerated. Also, the presence of the turnbuckle safety wire, combined with the location beneath the heating duct, makes corrosion and cracking difficult to detect. Some of the reports of failed cable end fittings revealed that the aileron cables had been held together only by the safety wire, while other reports were of complete aileron cable separation.

According to the Special Airworthiness Information Bulletin (CE-19-13) issued in July 2019 on turnbuckle connections used in mechanical flight controls, the factors that contribute to stress corrosion cracking for stainless steel fittings of this type are exposure to contamination (chlorides) along with being under sustained tensile stress. Heat is also a contributing factor. It is therefore likely to occur more quickly in a warm, humid, salt air environment, and progresses based on calendar time rather than flight time. Based on multiple part examinations, the stress corrosion cracking originates at general corrosion pits on the surface of the parts. Because the cracks are primarily below the surface, they can be extremely difficult to detect.

If you're qualified to inspect your own aircraft, consult the service manual and be aware that multiple failures of an aileron cable terminal have occurred in a location just forward of the rear spar and underneath a ventilation/heating duct. This applies to most Beech model 33, 35 and 36 planes manufactured between approximately 1964 and 1977, after which the aileron turnbuckles were moved to a location in the wheel well (there may be exceptions falling outside those years). Even with a 10X magnifier, spotting the issue might not be readily apparent.

Depending on whether safety wire or a safety clip is used to secure the turnbuckle, any corrosion such as this may be hidden from view by the safety wire, which needs to be removed in order to perform an adequate inspection. Being located in close proximity to the airplane battery can also be an aggravating factor. Based on reports received to date, the FAA would not expect failures to occur on parts with less than 15 years' time in service.

WHAT CAN GO WRONG?

The answer should be obvious. If the hardware separates, there will likely be an uncommanded right roll of the airplane and loss of roll control in the left direction. You do conduct flight control checks before every flight, don't you? This issue speaks volumes for the importance of this preflight exercise.

As for cost, the inspection alone (roughly five hours) could run close to $500 at typical shop rates, while replacement of a forward aileron cable could run north of $1600 including parts and labor. Add another $1100 if the aft aileron cable needs to be replaced.

Link to the AD at tiny.cc/3e1igz.

Diamond DA40 Star:

Owners give it high marks for build quality, ergos and pleasant handling.

CHECKLIST

- Above all, the DA40 Star has an impressive safety record.
- Glider DNA makes it efficient and a Lyc IO-360 makes it reliable.
- Early G1000 models have limited ADS-B In potential. Some don't even have WAAS GPS.

You don't need to spend much time with a Diamond DA40 to recognize its glider roots, which the company started out producing when it was Hoffmann Flugzeugbau. From the long efficient wings to the stretched-out seating and well-executed ergos, the four-place DA40 is sleek, efficient and has timeless good looks.

The DA40 has a small fuselage, but don't let the exterior fool you. The aircraft's cabin is roomier than it looks, plus it has control sticks instead of panel-blocking yokes, which makes the cockpit a better place to be.

Best of all, the composite DA40 is mild mannered. It handles stiff crosswinds with ease, plus the accident reports consistently rank the airplane more favorably than others in its class if the pilot brings the A-game. The DA40 could very well have one of the best outcomes for post-crash fires of any small GA airplane—we've yet to hear of one melting.

One of the DA40's strongest suits is the fabulous visibility afforded by the wraparound canopy.

MOTORGLIDER ROOTS

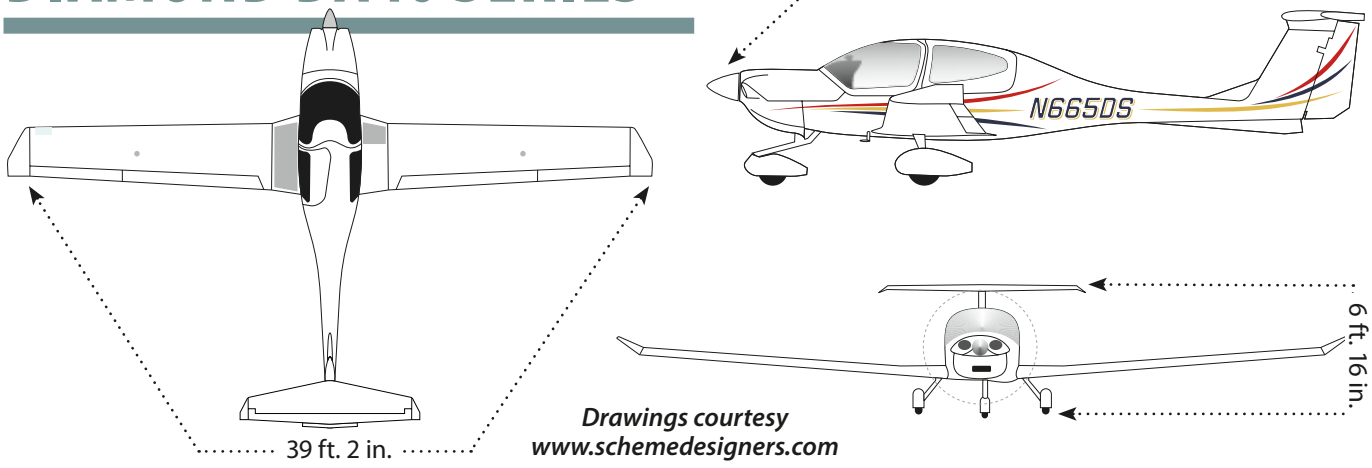
Flash back to 1981 in Friesach, Austria, where Hoffmann Flugzeugbau began producing the H36 Dimona motorglider, a popular recreational airplane in Europe. Ten years later, Christian Dries and family took over Hoffmann and in 1992, it launched an effort at the North American market by opening a new plant in London, Ontario, in a converted World War II aircraft factory.

Diamond—then called Dimona—got its feet wet in the U.S. market by importing the Austrian-built DV20 Katana. In 1995, it began building Rotax-powered DA20-A1s in the London plant and selling these into what was then a lukewarm market for new trainers. By the time the company changed its name from Dimona to Diamond in 1996, it realized that both the North American and world markets had room for a composite four-place airplane.

In 1997, Diamond announced the DA40 Diamond Star at the big European show in Friedrichshafen, Germany, with the prototypes powered by the Rotax 914 and Continental IO-240. But the airplane clearly needed more power. In 2000, the DA40-180 was certified with the reliable Lycoming IO-360 and a year later, production began in the London plant. Sales were initially brisk, especially to the trainer market which, increasingly, was turning to Cessna 172s for new training aircraft. Many flight schools found would-be students weren't as price-sensitive as they once thought and wanted the option of two additional

That's a late-model DA40 in the lead photo. As an example, a 2016 DA40-XLT has a Bluebook suggested price of $415,000, but early models are down, and typically priced around $100,000.

DIAMOND DA40 SERIES

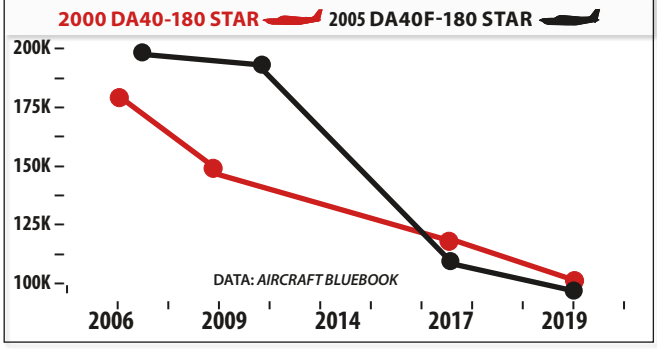


Drawings courtesy www.schemedesigners.com

DIAMOND DA40 STAR SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
2000 DA40-180 STAR	LYCOMING IO-360-M1A	2000	$25,000	40	915 LBS	145 KTS	±$85,000
2004 DA40-180 STAR	LYCOMING IO-360-M1A	2000	$25,000	40	915 LBS	145 KTS	±$105,000
2005 DA40F-180 STAR	LYCOMING O-360-A4M	2000	$23,000	40	915 LBS	135 KTS	±$80,000
2006 DA40-180 STAR	LYCOMING IO-360-M1A	2000	$25,000	40	915 LBS	145 KTS	±$125,000
2006 DA40F-180 STAR	LYCOMING O-360-A4M	2000	$23,000	40	915 LBS	135 KTS	±$85,000
2007 DA40F-180 STAR	LYCOMING O-360-A4M	2000	$23,000	40	915 LBS	135 KTS	±$90,000
2007 DA40-XL STAR	LYCOMING IO-360-M1A	2000	$25,000	40	860 LBS	150 KTS	±$180,000
2011 DA40-XLS STAR	LYCOMING IO-360-M1A	2000	$25,000	50	860 LBS	150 KTS	±$250,000
2013 DA40-XLS STAR	LYCOMING IO-360-M1A	2000	$25,000	50	860 LBS	150 KTS	±$310,000
2014-17 DA40-XLT STAR	LYCOMING IO-360-M1A	2000	$25,000	50	860 LBS	150 KTS	±$450,000

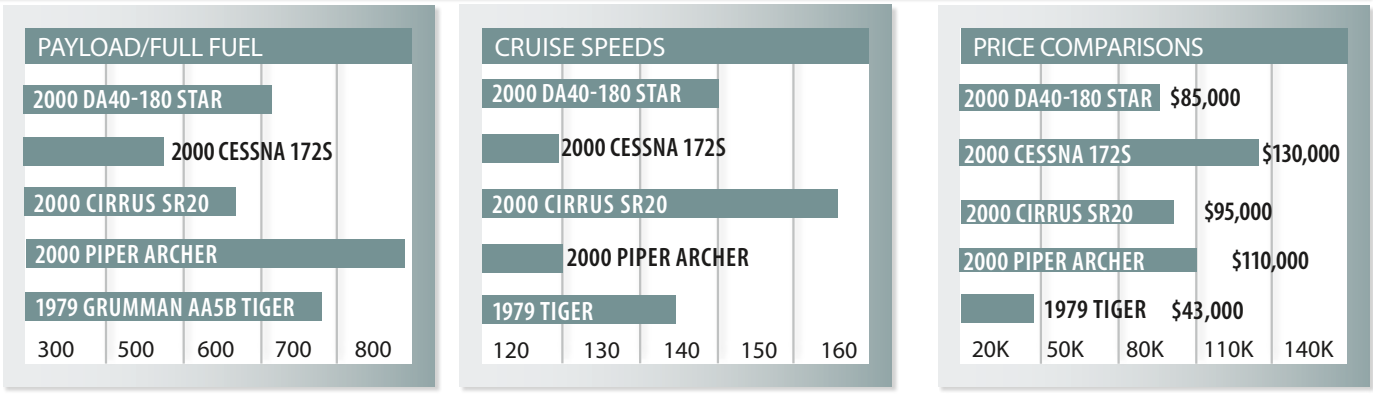
DIAMOND DA40 RESALE VALUE



SELECT RECENT ADs

AD 2010-25-01	REPLACE REAR DOOR RETAINING BRACKET
AD 2009-10-04	REPETITIVELY INSPECT NOSE LANDING GEAR LEG FOR CRACKS
AD 2007-11-21	REPETITIVELY INSPECT FUEL SELECTOR UNIVERSAL JOINTS
AD 2006-12-07	REPLACE CERTAIN ECI CYLINDERS ON LYCOMING -360 AND -540 ENGINES

SELECT LATER-MODEL COMPARISONS



Starting in 2004, the all-electric DA40 got the Garmin G1000, top photo. Upgrading these early G1000 systems to WAAS and ADS-B is a sore subject among owners. They still can't display ADS-B weather. Earlier aircraft had traditional flight instruments and stack-mounted radios, bottom.

seats, which the Katana couldn't provide. When it initially appeared in the 2000 model year, the DA40 sold for $189,900, typically equipped. Today, that 2000 model-year DA40-180 Star has an *Aircraft Bluebook* average retail value of $85,000.

Initial deliveries of DA40s were equipped with dual Garmin GNS 430s and BendixKing KAP140 autopilots. In 2004, Diamond announced that new Stars would have the Garmin G1000 integrated avionics system and that same year, Diamond announced a joint venture to sell and build DA40s for the Chinese market, primarily for training in that country's burgeoning airline sector. Knowing it had found a niche, in 2005, Diamond announced the DA40-FP, a fixed pitch-only version of the airplane, with the carbureted Lycoming O-360. This model was aimed specifically at the training market. The FP's base price at the time of introduction was $187,800.

In 2006, the DA40-XL appeared, which was basically just packaging of high-end options, such as the Garmin GFC 700 autopilot, Power Flow exhaust system, a composite three-blade MT prop, a 110-pound gross weight increase, electrically adjusted rudder pedals and a premium interior.

The airplane was clearly aimed at the upscale owner-flown market, which Cirrus was having good success serving. Fully equipped, the XL model sold for $329,000.

In late 2007, yet more versions of the DA40 appeared, the XLS and the CS. The XLS has a wider, higher canopy and a luxury interior while the CS is essentially an à la carte model with a constant-speed prop that lets flight schools configure it with interiors and other options. The base price of the CS was $259,950, while the XLS base was $334,950, or over $380,000 fully loaded.

CLEAN CONSTRUCTION

When Diamond bought Hoffmann, it paid attention to the company's core expertise: building clean, strong glass structures. This is definitely reflected in the DA40's construction, which was built along the same lines as the two-seat Katana/Evolution/Eclipse series.

The fuselage is constructed of wet layup material in two halves that are bonded together longitudinally, with the vertical stab as part of the assembly. The T-tail is attached separately, as are the wings which, unlike the Cirrus aircraft, are two separate pieces joined at the fuselage center section. The wings themselves are laid up top and bottom in vacuum molds, then bonded together after the internals are installed.

The spar is a massive twin carbon-fiber spar layup between which the fuel is stored in removable aluminum cells. The fact that fuel is exceptionally well protected may explain why Diamond aircraft have shown no tendency toward post-crash fires.

The cabin and cockpit is best thought of as a bathtub arrangement with a wraparound canopy in the front and a hinged rear hatch for the backseat occupants. The canopy hinges at the front, rather than the rear, as on the DA20. The rear hatch is on the airplane's left side and is equipped with a pin release for emergency egress. As with most of

Interior appointments got better as the DA40 matured. The front seats don't slide forward or aft, but the rudder pedals adjust. The rear cabin, bottom, isn't cavernous by any means, but on par with other four-placers in its class. There's useful storage space behind the rear seats.

the modern composite aircraft, the DA40 has spring steel gear and a castering nosewheel, with steering via differential braking. The gear attach point loads are carried into the center section through attachments on the spar.

Unique among the big three composite lines—Cirrus, Columbia/Cessna (the TTx is gone, of course) and Diamond—the DA40 has center sticks with push-pull rods for elevator and ailerons and cables for the rudder. Rather than sliding seats, the DA40 has pedals that can be repositioned to adjust legroom. Trim is both electric and manual—there's a trim rocker on the sticks and a center console wheel—and is activated by cables to an anti-servo tab on the horizontal stab.

ENGINES, SYSTEMS

Diamond kept it simple when it came to the powerplant: Lycoming's 180-HP IO-360 has proven reliable and inexpensive to overhaul, at the expense of giving up some smoothness to six-cylinder Continentals. It's also fairly light, an advantage in an airframe as light as the DA40. Gross weight in early models was 2535 pounds, while newer ones are 2645, compared to 2450 pounds for the Cessna 172 and 3050 pounds for the Cirrus SR22.

In 2014, Diamond brought the DA40-NG to market. Equipped with the 168-HP Austro AE300 diesel engine, the current *Aircraft Bluebook* shows a 2015 model retailing for $435,000. The engine has an 1800-hour TBO and a $30,000 typical overhaul cost.

Systems-wise, the Star has all the required new-age glitz. The fuel system has right/left/off settings, only one step down from the ideal off/on system for minimizing fuel-related accidents. However, as there have been no fuel-related accidents reported on Diamond Stars in the U.S., we're hardly one to complain. The fuel selector is on the center console. One of the airplane's operating limitations includes a requirement to keep the fuel load balanced.

As is the fashion, the DA40 is an all-electric airplane, with no vacuum system. It has a single battery, but also a single alternator, although there's a battery backup for the electric gyros.

One of the DA40's strongest suits is the fabulous visibility afforded by the wrap-around canopy; nothing else in GA comes close. But what plastic giveth, plastic taketh away. The cockpit can be boiling hot in the summer, although an opaque shade along the top of the plastic bubble helps. Air conditioning is an aftermarket option in the DA40s. However, the canopy can be opened during taxi and is equipped with partial-open latches. The heating and ventilation, once airborne, are good. In early models, the panel air vents emitted a noticeable and irritating howl, although some owners have found their own fixes for this.

PERFORMANCE, LOADING

When we reviewed the first production model DA40 in 2002, it blew away the competition, mainly the Cessna 172 and 172SP and the Piper

The DA40's big canopy means impressive visibility in flight, if not a hot cabin in warm climates. A set of Jet Shades helps. The Lycoming IO-360, bottom, is the right match for the DA40.

Archer, both entry-level four-placers. Only the Tiger comes close in older designs, although the Cirrus SR20—also entry level—is faster by about 10 knots or so on 20 more horsepower. It easily kept up with the 200-HP Piper Arrow. The early Stars run around all day on 9.5 to 9.8 GPH at speeds up to about 140 knots. Subsequent models, say owners, are about 10 knots faster and, for the DA40-XLS, Diamond claims a 158-knot top speed with a 150-knot cruise on 10 GPH.

With its long wing and relatively high aspect ratio—reflecting its sailplane heritage—the Star is a terrific climber, even when loaded. Moreover, it leads the league in short-field capability, easily hopping off the runway in 1200 feet or less with a heavy load. At 2535 pounds (2645 for newer models) gross, the Star is light; at 14 pounds per HP, its power loading puts it in the middle of its class. (The Cirrus has power loading of 15.25 lbs/HP, while the Cessna 172 is lower, at 13.6 lbs/HP.) Nonetheless, any competent pilot should be able to comfortably operate a Star out of 2000-foot runways, at reasonable density altitudes.

Payload-wise, the Star is really a three-place airplane with baggage space, even at the higher gross weights. Useful loads are in the 850-pound range, although some owners report less.

So with the tanks full, it can carry about 600 pounds—three people with some bags. There's a 10-gallon extended-range fuel tank option that reduces cabin load.

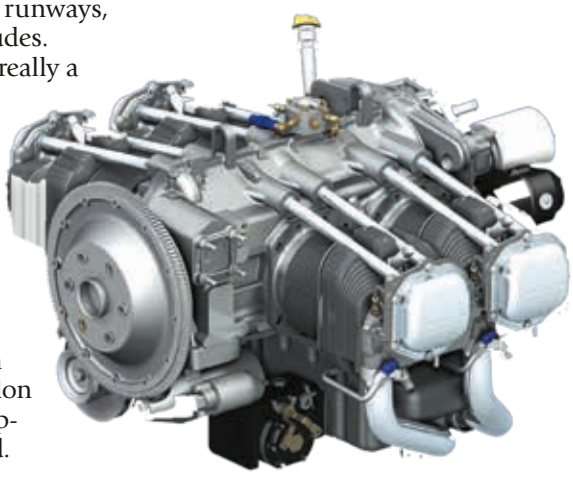
In early Stars, the baggage compartment was a bit of an afterthought, accessible only through the cabin by tilting the rear seats forward. The area itself was quite shallow. This was later redesigned, and now the rear seats fold forward to essentially turn the backseat into one huge baggage bay.

The Star's weight-and-balance envelope is relatively benign, narrowing a bit toward the gross weight limit. Early models tend toward forward rather than aft CG. Offloading fuel is always an option to stuff in more payload, but the airplane carries only 40 gallons usable to begin with, so its range is hardly exceptional. The 10-gallon extended range option helps, but owners complain it narrows the CG envelope, something that needs watching. The newer XLS models come with 50-gallon tanks as standard.

HANDLING, ERGOS

Entering the Star's cockpit requires hiking up onto the wing and stepping down into the well of the cabin. It's a bit of a practiced art, requiring gripping the canopy's tubular hinges to gain purchase, both for ingress and egress. Not easy, perhaps, but you get used to it.

The rear seat passengers simply step through the hatch and into the rear cabin, which is quite spacious. (Watch the opened rear hatch,



The DA40 is a pussycat in the runway environment. It really doesn't have any bad habits and with the right technique it's forgiving in crosswinds.

though—it's just the right height to bonk an unwary head.)

The front seats don't slide fore-and-aft, but the rudder pedals adjust. A 6-foot-5-inch owner reported that, while a little cramped, the pilot's seat has adequate room for him. Rear-seat passengers enjoy adequate footroom, thanks to footwells. With the adjustable rudder sets, the front seats have good legroom for such a small aircraft. As noted, cockpit visibility is nothing short of fabulous—the best of any GA airplane, other than the Katana/Evolution/Eclipse series.

Of all the GA airplanes we've flown and tested, the Star ranks at the top as being the most fun to fly. It's not quite as well balanced as a Bonanza, but it has no bad habits, and pitch and roll forces are light and easy to manage with the stick. Slow flight and stalls are non-events and even deep into the stall, the airplane simply mushes and could probably touch down that way in a survivable impact. Flaps have little or no effect on trim condition, but neither are they as effective as the barn doors on a Cessna 172.

Landing a Star isn't particularly difficult, but the sight picture over the nose requires some acclimation to avoid too-high flares. Flown into the flare faster than about 65 knots, the Star will float, so slower is better.

MAINTENANCE, MODS

The Lycoming IO-360 is one of the most reliable four-cylinder powerplants available; we heard no complaints from owners about it, save for a few owners who had problems with electric fuel pumps.

Some owners complained of early teething problems with the Garmin G1000. We also heard plenty of complaints about Garmin and Diamond being slow to produce software upgrades for non-WAAS aircraft. The early Star's weak landing lights are a point of contention. We found only four ADs against the airplane, one requiring replacement of the rear hatch retaining bracket, one requiring inspection of the nosegear pivot axle, one requiring inspection of the universal joint on the fuel switch and the last requiring a one-time fuel system inspection.

As for aftermarket mods, there aren't many. Florida-based Premier Aircraft (also a Diamond dealer) offers the Cabin Cool air conditioning system, the PowerPlus standby alternator system and a stylish and functional interior upgrade package. There's a also a custom exterior striping package, plus for better climb and couple extra knots in cruise, a Hartzell ASC composite propeller is available. Contact www.flypas.com.

There's also the Forced Aeromotive supercharging mod (www.forcedae-

DA40 ACCIDENTS: WHAT ACCIDENTS?

You know the routine—every month we review the NTSB reports of the 100 most recent accidents of the type of airplane featured in the Used Aircraft Guide. We then pigeonhole them by cause, looking for areas of concern for buyers and users of those airplanes. Not surprisingly, having a reasonably large number of accidents to review has allowed us to identify troublesome components or systems that increase accident risk such as fuel-related engine stoppage crashes in airplanes with multiple fuel tanks.

Then we got to the Diamond DA40. Over a production run of nearly 20 years, more than 2000 DA40s have been built and, from what we can tell, well over 1000 are in the U.S. However, when we pulled up all of the NTSB reports of DA40 accidents, we found 51. That number included such events as a pilot who improperly set the parking brake and coasted slowly into the side of a hangar while he was looking down, thinking the airplane was parked, and damage to one brake when a DA40 hit a coyote on a night landing. Those were two of several reports on events that involved so little damage that they didn't meet the threshold to be called an accident under the NTSB regs.

We've noted the low accident rate of the DA40 series in the past. Our most recent sojourn through the NTSB reports confirmed that the notable thing about DA40 series accidents is their relative absence.

Not having a 100-accident statistical universe for the DA40, we'll nevertheless look at areas where we have expressed concern with other airplanes and see how the Diamond fared.

Runway loss of control (RLOC) is, in our opinion, a powerful indicator of the quality of the aircraft's ground handling, which is why we see a RLOC rate of tailwheel airplanes that is usually two to three times that of nosewheel machines. For the DA40 we found 11 RLOC events; all involved a crosswind and a majority also involved student pilots. That 22% of the total accidents is average for a nosewheel airplane, although our experience in the DA40 indicates that it handles crosswinds slightly better than its peers.

There were three DA40 crashes where the pilot aborted a landing and then either stalled the airplane on the go-around or stuck the wing into an obstruction. What was significant to us was the absence of serious injuries to those involved.

We think highly of the crashworthiness of the DA40 design. It was confirmed in the reports we reviewed. One involved an optimist with three passengers tracking elk in the mountains of Utah. You guessed it. He flew into a canyon too tight to make a 180. He climbed for all the airplane was worth and flew into trees on rising terrain at just above stall speed. Two occupants received minor injuries; the other two were uninjured.

A VFR pilot stuck on top dove his DA40 into a hole between clouds. Emerging at the bottom he had an up-close-and-personal view of the ground. Giving his all, he pulled up and almost made it. He hit treetops and came to a stop. No one in the airplane received more than minor injuries.

A pilot who was not current at night tried to land on an unlit runway. He hit a tree with a wing and spun into the ground. Again, no more than minor injuries.

Impressively, we found no fuel-related accidents and only two engine stoppage in flight events.

Sadly, a good aircraft design does not insulate it from stupid pilot tricks. One pilot, with a passenger, repeatedly buzzed a friend's boat. The passes, complete with steep pull ups, continued until the pilot hit the water at high speed and the airplane broke up.

romotive.com), and while we'll look at supercharging in a separate article, the kit for the Diamond is $30,150. Yielding max continuous true airspeed of 164 knots at 8500 feet and far better climb at higher altitudes, downtime for the upgrade is roughly 16 days and adds 18 pounds.

There's also removable Jet Shades (www.jetshades.com) to keep the DA40's cabin cooler in flight.

OWNER COMMENTS

We flew our much loved Citabria for a few years before we decided to buy a Diamond Star DA40. We moved to Florida and the two-seat Citabria could only carry one of our visiting guests at a time, so we wanted something small, slow and economical to take three people up at a time for some low-altitude sightseeing flights here in the Florida Keys. We also wanted to be able to carry more/heavier loads than the Citabria could so the Diamond fit that bill very nicely. I'd already sold my complex high-performance Trinidad because it was hangared in Connecticut and I wasn't available to fly it after moving to Florida.

The back two seats of the DA40 conveniently fold forward for storing even somewhat large baggage. The Trinidad had an odd-shaped baggage door, although it would take considerable poundage in that area. The gullwing passenger door on the left side of the DA40 makes it easy for loading for larger people or cargo. I also like the large forward-lifting front canopy. The view is about as good as glider's. Being a low-wing airplane as my Trinidad was makes for convenient fueling. No more hauling and climbing up the ladder for each wing refueling for this 72-year-old lady as was necessary with the Citabria. The DA40 has a stick, like the Citabria.

The Trinidad has a wider cabin compared to the DA40. Luckily, I'm a small woman and my husband is about 175 pounds, so it isn't a big problem for us. It would be a squeeze for two 250-pound men, but so would any other small piston airplane. The DA40's rudder pedals are adjustable while the seat is fixed. Being a small pilot I've used a seat and back cushion when flying the Trinidad, the Citabria and the DA40. I really do like the ability to keep the

DA40 canopy latched opened about one inch while taxiing. I didn't have that feature in the Trinidad. In the Citabria, I had to open the window when taxiing in the hot climate. The DA40 requires a lot of right rudder as you gain speed on the runway.

When we purchased our 2005 DA40 I was used to flying our Pilatus PC-12NG. Oh, no—it seemed like a step backward having throttle/prop/mixture controls that I'd had in the Trinidad. I was spoiled by the PC-12 simplicity in having just a power lever to deal with. Fortunately our DA40 has the Garmin G1000 with lean assist mode, which I find helpful. It's taken a while for me to get dialed in to my exacting standards on fuel flow/temps, but I'm now comfortable with it. The Trinidad handled turbulence very well compared to the lighter Diamond. Still, I don't find the ride in the Diamond Star noticeably bumpy.

Landing the Trinidad with its trailing link landing gear made every landing look good. The Diamond Star has fixed gear, which isn't quite as forgiving. When landing with only one notch of flaps, be prepared to float quite a bit. Even with full flaps, it seems to float some unless you are right on target with speed. And I admit to often being a bit faster than that. Full flaps on final approach with both the DA40 and the Trinidad means you will come down very fast if you don't keep enough power.

The DA40 is more economical than the Trinidad and less economical than the Citabria. Each has its advantages and disadvantages. It's been a love affair in each case. (But as we know of any love affair, there's always something less than perfect to manage.) Currently, the DA40 fits the bill nicely for what my heart desires at this point in my life. However, my next Diamond Star will have a touch of red paint to spice it up.

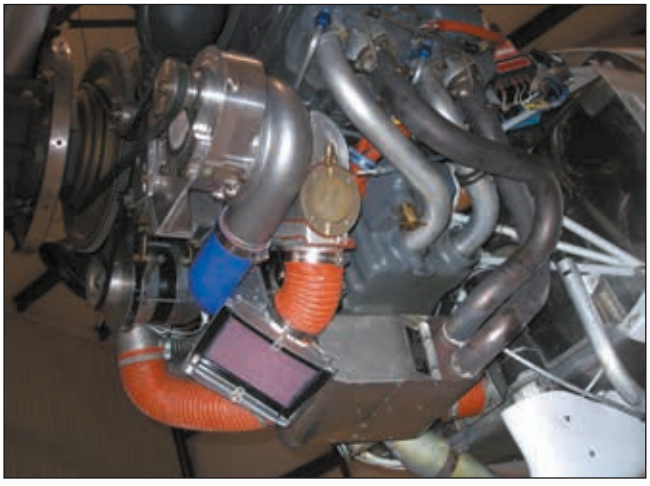
Susan Simmons
Marathon, Florida

When I was finally in a position to purchase an airplane I wanted to pick a model that I would still want 20 years down the road. I wanted my first plane to be my last plane so I picked the DA40 because it seemed to fit that bill. I loved the modern looks, comfortable seating and modern avionics, which aren't so modern any more. The visibility is great here in the Pacific Northwest because we tend to have a lot of cloud cover, but on very sunny days and in warmer climates the great bubble canopy can be a heat problem.

On the Diamond Aviators forum (www.diamondaviators.net) it's obvious that there is a good bias for the DA40 as being the best in its category, but there is always room for improvement. On one specific thread I recall someone asking "How can you make the most perfect airplane more perfect?" The answer was clearly to have more power up higher. I recall one uncomfortable flight climbing to clear a mountain pass with the seats full, although easily under gross. At about 10,000 feet I was barely able to get 400 FPM at a reduced speed that was causing my CHTs to exceed 400 degrees. That flight made a big impression on me. So when a year later I received a mass mailing advertising the Forced Aeromotive supercharging mod for a Cessna 206, I asked if there would be a mod to supercharge a DA40. My Diamond ultimately became the guinea pig for a seven-year project (new record?), which resulted in an STC to put a belt supercharger on the DA40's IO-360. The most perfect plane is now more perfect and has more utility.

In those seven years, my plane was not often available since it spent most of its time in Denver, Colorado, and I live in Vancouver, Washington. I've owned two other planes in that time. First a Just Highlander, which opened my eyes to the fun of STOL operations, and then a Glasair Sportsman, which I still own. I was thinking that once the supercharging STC was completed that I would sell the Diamond and be done with it. But when the DA40 came back home and was tucked into the hangar and I started to fly it, I remembered why I love the DA40 so much. Great lines and it fits like a glove. I love the long wings, the handling, the view, the center stick and the rear door.

The cargo area is really quite generous especially with the rear seats folded down, but it would be so much better if Diamond had made the seats fold down flat and latch with hard-point tiedowns—much like the old country squire



That's the Forced Aeromotive supercharging mod under the newly painted cowling of a DA40. Owners report sizable speed and climb rates above 7000 feet with this $30,150 upgrade.

The Aviation Consumer

Used DA40 Star

(continued from page 31)

station wagons of old. I really like the Sportsman as it better fits my mission and the joy of owning and maintaining an experimental (EAB) fits me as I have trouble leaving well enough alone and I enjoy making changes. But after 13 years of ownership (purchased new in 2006) the DA40 continues to be my first-love airplane, and I struggle to decide which plane I'm going to part with as I really don't need two planes

As for mods, I'm an early adopter and am continuously tweaking. The first mod was the Power Flow exhaust. It made a noticeable difference from the first takeoff. It's now standard equipment and most planes have been upgraded. Next came the Electroair electronic ignition. I really appreciate the electronic mag but am not a great fan of its multiple components, plus I had some trouble with it early on but it's worth having. I upgraded the landing/taxi lights to HID (huge improvement) though there are probably LEDs now that would be even better. Next was LED nav/strobe wingtip lights to replace the Whelen flash bulb lights. I installed a RAM ball mount on the panel to hold my iPad mini, and now the iPad sits just in front of the pilot's air vent, which keeps it cool. The last mod was the supercharger.

Currently I am in the process of installing the Garmin GTX 345R for ADS-B In/Out. The traffic will show on the G1000, but the software will have to be upgraded (when pigs fly) before the weather will display on the G1000. So I'll still retain a Stratux ADS-B receiver and my iPad for displaying weather. Down the road I might get a set of pricey Jet Shades for the cabin/canopy.

Also being installed is a taller landing gear, which became available in 2007. The tail skid on my DA40 is 18 inches from the hangar floor when loaded with full fuel and no people or cargo. It's reported that a newer DA40's tail skid is around 24 inches from the floor. Since I operate out of a 2500-foot grass runway this will make a big change as I am limited in flare and rotation. It's common to have to pull weeds from the tail skid. Speaking of sod runways, I have to leave the main gear wheel fairings off as they have been cracked more than once on the soft ground. The nosewheel on these planes continues to get canted after takeoff, which causes the need for rudder pressure. It's a known issue and has been largely figured out by folks on the forum. One owner is working on a fix that installs a small aerodynamic fin on the nosewheel fairing.

The Garmin G1000 integrated avionics suite looked really great (and still is in many respects) when new, but because it is not being updated it's very quickly been eclipsed. I now wish mine was one of the earlier round-gauge aircraft as they are so very easy to update. My Sportsman has an AFS-5600 and Avidyne IFD540 installed. It has a fraction of the components yet flies circles around my non-WAAS G1000.

I'm convinced that integrated avionics are perfect in commercial aircraft that fly constantly and will be worn out before the avionics get old. However, for GA, discrete components make much more sense in so many ways. I think the industry needs to take a close look at its efforts to sell more planes by making them near impossible to update. I think it's a marketing Catch-22. Why would an airframe manufacturer keep updating the avionics of older planes when that reduces the number of new planes it might sell? It might even hurt sales of new Diamond models given the history of the DA40's avionics being left behind. I believe one answer is to get rid of the integrated suites—like the aging G1000—in favor of retrofit systems.

Brock Steiner
via email

PIPER ARCHER CHEROKEE 180

It's time to take a look at the used Piper Archer and Cherokee 180 market market for the *Aviation Consumer* Used Aircraft Guide. We want to know what it's like to own these trusty singles, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your Piper to appear in the magazine, send us any photographs (full-size, **high-resolution**) you'd like to share to the email below. We welcome information on mods, support organizations or any other comments. Send correspondence on the Archer/180 by March 10, 2020, to:

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e-mail at:
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