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The consumer resource for pilots and aircraft owners

The Aviation Consumer®

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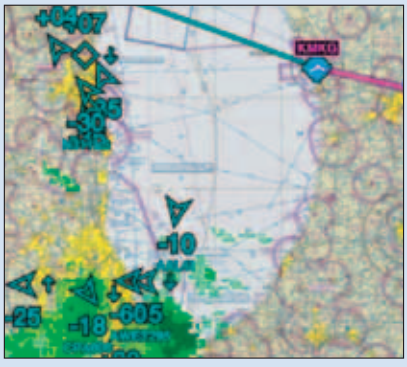

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The Aviation Consumer

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The Watch Changes

A couple of years ago when I was having fun chasing down all the doublespeak larding up the avgas replacement effort, NATA President Jim Coyne made a comment to me as we were leaving yet another information-free meeting masquerading as a press conference. "You know," he said, "you were born for this."

Jim is an old-school airplane guy from back in the days when the industry was a friendlier place than it is now and he's a long-time aircraft owner and reader of *Aviation Consumer.* He knows me well enough to sense my unrestrained glee in pursuing stories that certain interests in the industry would rather see kept in the shadows. This natural predilection springs from my experience as an unreconstructed hooligan in Catholic school and was further reinforced early in my career in the newspaper business, where wide-eyed awe is checked at the newsroom door.

But at some point, the fun always ends, does it not? And so effective with this issue, I will be handing over the editorship of *Aviation Consumer* to my colleague Rick Durden. He's been ably editing our sister magazine, *IFR Refresher,* for several years and is the perfect guy to assume the reins of the only magazine in aviation publishing that still offers an honest and independent critical voice free of commercial influence. He'll be assisted by our highly capable avionics editor, Larry Anglisano.

Obviously, for me, stepping down is no easy decision. Jim was right. When I stumbled into the editor's chair of *Aviation Consumer*—really, it found me—it felt like the perfect match for my skills and outlook. I have enjoyed it immensely. But after 18 years, it's time for new eyes on the project and a fresh perspective.

The considerable reward of having edited this magazine is its readers. All of Belvoir's titles are uniquely married to the interests of their audiences, which are discerning, demanding and engaged. There's no more satisfying experience for an editor than publishing for readers who are paying attention. So to our subscribers, I offer my heartfelt thanks. It has been a rare privilege to serve you.

A word about Belvoir Media Group and its unique culture. Our chairman, Robert Englander, likes to say that when you do a great job around here, we ignore you. As it turns out, not everyone thrives on being ignored, but I do. I've always felt comfortable in providing readers with useful, well-packaged editorial and I don't need a bunch of suits second-guessing me. At Belvoir Media Group, they don't.

What they do provide is an exceptionally supportive environment for real journalism, with no not-so-subtle directives to lay off advertisers or small herds of sacred cows grazing unseen amidst the pages. I have been blessed to have worked in such a place and I'm profoundly grateful that Belvoir continues to maintain it for those who will follow me.

What's next? I'll remain on the masthead as a regular contributor to *Consumer* and will continue my duties as editorial director. I'll also be working on new projects, including more features and a redesign for our sister online publication, *www.avweb.com*. I relish the change and hope you do, too.

—Paul Bertorelli

Electric Airplanes

When considering the viability of electric-powered aircraft, it's important to note the huge difference between the internal combustion (IC) engine that burns hydrocarbon fuels and an electric motor that relies on a battery energy source.

The ratio of air mass to fuel mass at efficient combustion (stoichiometry) is about 14.6. That is, for every pound of fuel burned, 14.6 pounds of air are consumed. But you don't have to carry the air since it is available in the atmosphere. Fuel weighs about 6 pounds per gallon, so 16 gallons of fuel weigh about 100 pounds. Over 1400 pounds of air will be consumed in burning that amount of fuel.

An electric motor requires that all of the energy be contained in the battery. Since the energy density of lithium batteries is about 26 times less than the energy of gasoline, there is nowhere for electric propulsion to go.

It is interesting to note that gasoline has 10 times the energy density of TNT that needs to carry its oxidizer within.

James Lemke
San Diego, California

More VGs

I wanted to write and provide my two cents' worth of experience on the topic of vortex generators, which I was excited to see covered in your June 2012 issue. I own a 1975 Piper Warrior—a solid and reliable airplane, but not exactly a high performer. About a year and a half ago, I picked up a vortex generator kit in person while I was up in Anacortes, Washington, at the Micro Aerodynamics hangar/offices.

After speaking for a half hour with Charles White in the Micro Aerodynamics hangar, I made the decision and never looked back. It was an easy and fun owner-assist install project under the supervision of my A&P/IA. Two evenings of work and I was done. And wow, what a difference.

As you noted in your article, the benefits will tend to vary from one airplane to another or even between two airplanes of the same year and model, since our aircraft are far from new or perfectly shaped.

In my case, the results were substantial: Stall speed was drastically lowered; aileron, stabilator and rudder control authority are all much better, especially at low speeds such as when landing; and—the most surprising part—my cruise speed was even increased by a few miles per hour thanks to the cleaner airflow over that seam,- rivet- and screw-covered wing.

My Warrior is still essentially the Ford Taurus of the skies, but it climbs and cruises faster, the controls respond with much greater authority, it takes off and lands shorter and flies quite slowly with confidence. It's nearly impossible to get it to fully stall and drop the nose since installing the VGs. It just bounces the nose up and down lightly from stall to flight.

I'd encourage anyone with an older airplane that has mushy controls when landing, or who wants a little better climb performance and/or added safety of lower stall speeds and better overall control, to give vortex generators a try.

Greg Hughes
Portland, Oregon

WHAT ABOUT T-CRAFT?

Jeff, I'm your favorite fan who currently owns a Taylorcraft. (I've actually had three over the years). We had a discussion about the last issue on LSAs.

Anyway, I enjoyed the latest article on the legacy LSAs. I see Paul absolutely, not once but twice, glossed over one of the fastest and cheapest LSAs out there. I know you must have had him do this on purpose just to see if I was paying attention.

I was very disappointed. I am also sorry I missed the AvWeb survey as I would have thrown my two cents in. Just like I stated, the poor Taylorcraft gets no respect, but it is one of the fastest, if not the fastest and cheapest-to-buy legacy LSAs out there. Also let Paul know he is getting screwed at those prices for the Cub. Hahaha!

Marty Towsley
Via e-mail

You found us out. Van West begged me, beseeched me to let him include the Taylorcraft in the legacy LSA article, just like I did when we did this article four years ago. Although I refused, he went ahead and did it anyway, right there on page 5.—Paul Bertorelli

GULF COAST FAN

I flew a long trip last week—Shenandoah, Virginia, to Naples, Florida,—

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NEW AIRCRAFT

Cessna's New Diesel: SMA SR305's OEM Debut

For a 16 percent price premium, the new 182 NXT will displace the Turbo Skylane. An early glance suggests that the numbers pencil out.

by Paul Bertorelli

If SMA's Jet-A burning piston powerplant looked promising when it appeared in 1998, it soon became the little engine that couldn't. A decade ago, interest in aerodiesels was lukewarm at best and SMA found no major OEM takers, either. But at AirVenture 2012 this year, Cessna's announcement to offer the SMA diesel in the Skylane might finally get the SR305 out of the starting blocks.

We knew Cessna was interested in diesel engines because two years ago, then-CEO Jack Pelton told us the company had tested all of the above-ground diesels, which included the Thielert and SMA offerings and we're sure they at least examined the Austro and Delta-Hawk. Although it seems obvious why Cessna picked the SMA in hindsight, it wasn't always that way.

With no small fanfare in 2007, Cessna announced it would offer the 172 Skyhawk with the Thielert 2.0 Centurion, the predecessor of which, the 1.7 Centurion, found surprisingly good sales numbers in the Diamond DA42 twin and DA40 single. But in a bullet-dodging bit of good luck worthy of a Roadrunner cartoon, Cessna got wind of Thielert's technical troubles with the engines months before Thielert went into bankruptcy in the spring of 2008. Cessna suspended the diesel program, evidently awaiting further developments.

WHAT CHANGED?

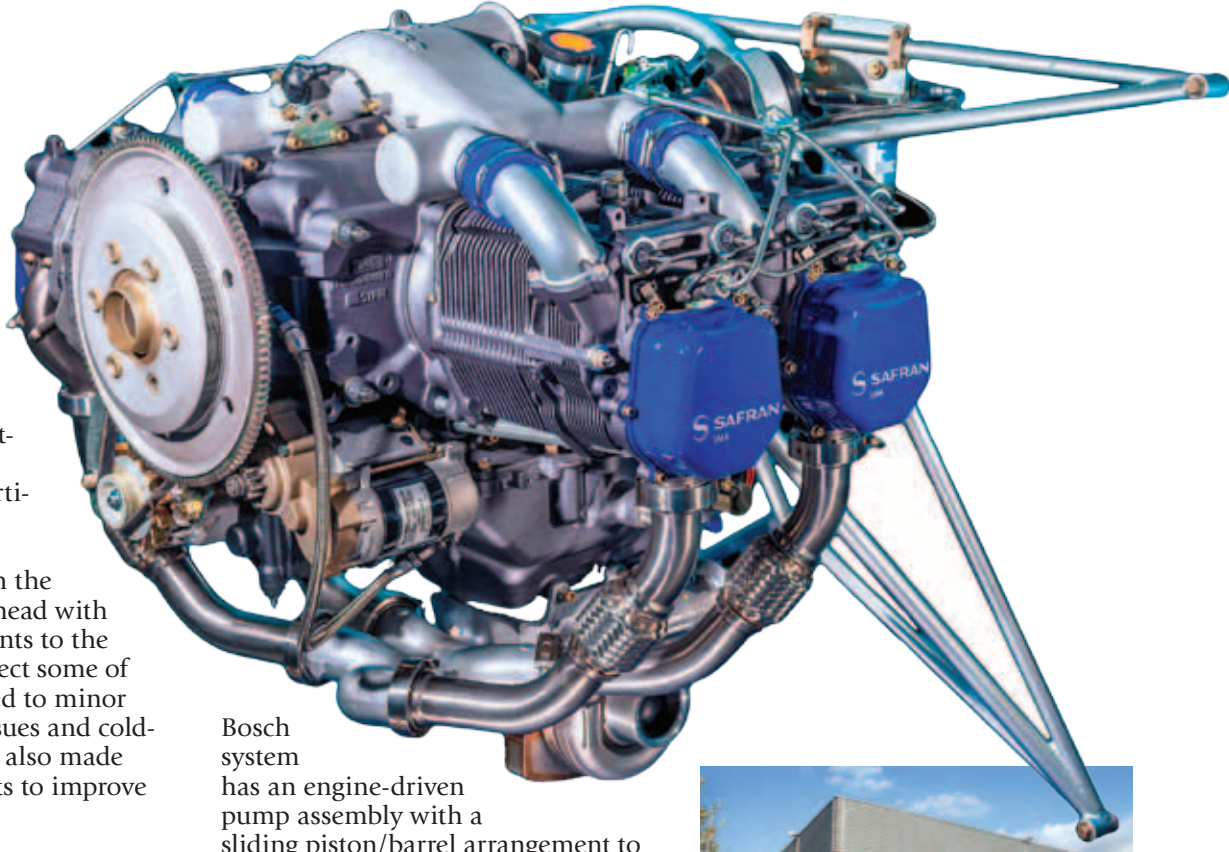
What moved Cessna off the dime and back into an active diesel program? At an AirVenture briefing, Cessna told assembled journalists that the market is asking for diesel engines, if not Cessnas with diesels specifically. Cessna's Jeff Umscheid picked the most well-worn cliché—game changer—to describe the new 182 NXT Skylane. Although he didn't say as much, Cessna was evidently waiting for the right engine and SMA—with an improved version, the SR305-230E—was the first to offer it.

The Thielert Centurion line has too little power to be suitable for the 182 and the Austro AE300 has the same shortcomings. The long-

At AirVenture, Cessna showed the new SMA-powered 182 NXT, top and left. The airplane is well into its certification flight trials.

CHECKLIST

- ⊕ Cessna finally makes good on its flirtation with the diesel airplane.
- ⊕ Claimed performance is as good or better than the T182T at a lower fuel burn.
- ~ Revised SMA305-230E has better turbocharging and fueling, but service history isn't established yet.
- ⊖ At $515,000, the 182 NXT is 16 percent more expensive than the T182T. Will it matter?



awaited DeltaHawk, although light, simple and powerful is, well, still awaited. Certification remains over the horizon. Two years ago, Continental announced its own diesel program using the SMA SR305 as a technological start-off point, but like the DeltaHawk, it's not certified yet.

Meanwhile, despite lackluster interest from the market, SMA forged ahead with significant improvements to the original SR305 to correct some of its shortcomings related to minor fueling and cooling issues and cold-weather intolerance. It also made changes in components to improve durability.

SMA 2.0

At AirVenture, SMA seems to have inverted its emphasis to highlight its parent company, SAFRAN, as a provider of the engine. SAFRAN is an aerospace giant, with products in the commercial transport, military and spaceflight segments. Notable at Oshkosh was that SAFRAN's nameplate was the dominant element in the signage and the promotional material. We think this is an intentional repositioning.

As for the base engine itself, the SR305 is a four-cylinder, four-cycle turbocharged diesel capable of burning various iterations of Jet A. Unlike the Austro and Thielert engines, which are automotive-derived, the SR305 was purpose-designed as an aircraft engine, thus its basic planform is similar to a conventional Lycoming or Continental. It has a split case with bolt-on cylinders, two valves per cylinder and a pushrod valve train. The heads are easily separable from the cylinders.

Compared to the Thielert and Austro offerings, the SMA is old school, with a Bosch variable-rack fuel injection system rather than the state-of-the-art high-pressure common rail systems found in typical automotive engines from which the Austro and Thielert derive.

Where those engines use electronic injectors capable of precisely metered and shaped fuel charges, the Bosch system has an engine-driven pump assembly with a sliding piston/barrel arrangement to meter the fuel mechanically through individual lines to each cylinder injector. It runs at less than half the pressure of common rail systems. But SMA's fueling gets a little help from an add-on electronic engine control that drives the rack more accurately through an electric motor.

The enhanced SR205-230E, above, has a new turbocharger, improved cylinders and better fueling, among many upgrades. SMA says its factory, above, will be ready for serial production by early next year. SMA had a decade-long proof-of-concept phase, during which it offered STC conversions for the Cessna 182, below. But it didn't sell the engines aggressively because it lacked a service network.

LIMITED AUTHORITY

On the plus side, the Bosch system is a proven, reliable performer, having first appeared in the automotive markets before World War II and it was in wide use by Mercedes-Benz during the 1950s and 1960s. On the other hand, compared to electronically controlled common-rail systems by Daimler-Benz, the Bosch design's ability to finesse fueling is limited. Electronically controlled fueling is the primary reason why modern diesels have vastly improved fuel specifics, power output and lower emissions compared to diesels of even 10 years ago.

Nonetheless, Cessna and SMA claim the SR305-230 is up to 42 percent more efficient than the gasoline engine it will replace in the Skylane and that its operational costs are

To solve the original SR305's minor operational issues, SMA improved the turbocharger, above, and redesigned cooling fins on the cylinders, right. It still uses the Bosch injection system, lower right, but fueling has been tweaked to address flameout worries at low power settings.

more than 50 percent lower.

At 455 pounds, it also has the best specific power of the certified diesels, although it's not the lightest in absolute terms. That distinction belongs to Thielert. The SMA SR305-230E has a specific power of .5 HP/lb, compared to .41 HP/lb for the Austro AE300 and .47 HP/lb for the latest version of the Thielert Centurion 2.0.

REVISED DESIGN

With only about 40 engines in the field—most in STC conversions of the Cessna 182—SMA has somewhat limited field experience with the SR305, considering the engine has been out there for nearly 15 years. Although this experience revealed few significant structural shortcomings with the design, the so-called Dash-1 version of the SR305 was hardly flawless.

Despite being turbocharged, it had boost limitations that hobbled its performance above 12,000 feet. It also had cooling issues and, as is the case with all compression-ignition engines, at lower power and boost settings, it was susceptible to flameouts. This required a minimum power setting on final approach that some operators complained about.

At AirVenture, SMA's Nicolas Mesnage, the company's chief of development, reviewed in detail for us some the changes made in the SR305-230E or "enhanced" engine, the version that Cessna will use in the 182. Improvements to the engine are best thought of as a constellation of minor changes that SMA says will have significant impact.

The most important may be a new, SMA-designed turbocharger with a higher compression ratio than the previous model had and this, along with some tweaking of the fueling, addresses the SR305's previous wheeziness at high altitude. The Dash 1 engine's output fell off sharply above 12,500 feet due to boost issues, but with the new turbocharger, the engine can maintain 75 percent power up to 20,000 feet, Mesnage told us during an interview at AirVenture.

Unlike the typical turbocharged gasoline engine, the SR305 turbo system is "free floating," meaning it doesn't have a traditional hydraulically controlled wastegate. What keeps it from bootstrapping, we asked? Mesnage explained that the turbo is designed to "self adapt" and that because of its high boost requirements—up to 94 inches—the engine can't be overboosted.

The new turbo, induction and fueling solves the engine's flameout problems, too. SMA addressed this in the Dash 1 by restricting the minimum power setting to something above idle. This proved to be somewhat of a flyability issue, especially on a high or too-fast approach. The enhanced engine can be idled and it also has better air restart capability. (When Cirrus flew the original Dash 1, it complained about problems with air restarts.)

Cirrus also had issues with cold weather starts and SMA has addressed this by adding a set of automatic glow plugs, one per cylinder. The plugs are used at temperatures of 20 degrees C or lower and heat the cylinder locally for 20 to 30 seconds before fuel is injected. The glow plug cycle is automatically controlled and shuts itself off.

Although SMA never fielded a large number of the Dash 1 engines, it did learn enough to redesign a number of components based on that experience. For example, the crankcase is beefier because some minor cracking was noted in harsh operating envelopes. Mesnage said SMA expects the crankcase to endure through three overhaul cycles, something that should reduce ownership costs if it proves true.

Furthermore, the cylinders have been redesigned to improve cooling. The original engine was air/oil cooled and so is the enhanced version. The oil is used to cool cylinder hot spots, so there's less need to get the baffling just right and fewer worries if it degrades in service. Along with improved cylinders, the new engine also has reworked pistons, which Mesnage said are also intended to last through three overhaul cycles.

SINGLE LEVER

Where the Thielert and Austro diesels rely on electronically controlled common-rail fueling, the SMA has a lower pressure system with plunger or piston-type rack control. It does have electronic aiding in the form of a linear variable displacement transducer—essentially a linear electric motor—that precisely adjusts the fuel rack according to the pilot's commanded throttle position.

Cessna's Charlie Wilcox told us that this setup can be thought of as "sort of" throttle by wire, since it uses data from a dual-channel electronic engine controller to optimize fueling efficiency for the commanded power. Because the Bosch pump remains a purely mechanical system,

manual reversion—invoked via a red lever on the throttle quadrant—gives the pilot direct control of the fuel rack via a traditional throttle cable.

Because of their vigorous torque pulses, diesels are hard on props and none of the current offerings are able to swing metal props. All have composite or wood-composite props, as does the SMA, either a Hartzell or MT three-blade design. What the SMA engine doesn't have is a gearbox. It's a direct-drive design with fixed governing to limit it to 2200 RPM. (It's a single-lever system; no manual prop control.) SMA managed this by sorting out the inertial components—crankshaft and connecting rods—and adjusting the fuel timing to minimize torque spikes. So, no prop or crankshaft damping at all?

"I don't like the word damping, because damping means losing energy," Nicolas Mesnage told us. "We try to avoid any damping inside the system. We arrange the inertia distribution to make it smoother."

One surprise revealed at AirVenture, in addition to the airplane itself, is that Lycoming will support the SR305 through its established service channels. That will eventually include overhauls.

"The engine is quite similar to the Lycoming engines for disassembly and inspection. There's nothing really different. That was a good surprise for the team from Lycoming when they were training," said Mesnage.

PERFORMANCE, INSTALLATION

We got a look at the SR305 installation in the 182 at AirVenture and although we couldn't compare it directly to the 182 SMA STC conversion we reported on in the January 2010 issue, there appear to be similarities.

At first glance, Cessna seems to have done a better job with the cowlings. The SR305 needs plenty of air for cooling and for breathing and Cessna provides it with generous scoops in the lower cowling that appear well integrated. If these add cooling or induction drag, Cessna's Charlie Wilcox told us it doesn't appear to ding performance.

On seven less horsepower than the Lycoming TIO-540-AK1A it replaces, the SMA engine delivers essentially identical performance, according to Cessna's initial test data. Specifically, Wilcox—who's lead test pilot in the certification project—says the SR305 delivers about 161 knots true on 12 to 12.5 GPH at 10,000 to 14,000 feet at 90 percent power. On paper, that's comparable to if not faster than the avgas-fueled T182T whose POH claims about 136 knots on 12.1 GPH at 65 percent power. Presumably, if the SR305 were throttled back to a like power output, its fuel consumption would be 9 or 10 GPH, but we don't yet have reliable numbers on this. We'll see when we fly it.

At its maximum altitude, the SR305 can still deliver 75 percent power for 154 to 155 knots on 9 GPH compared to 147 knots on 12.1 GPH for the gasoline engine. Note that these are preliminary data; we haven't flown the airplane nor seen the final POH claims.

In its promotional material, SMA claims a brake specific fuel consumption of .365/pounds/HP/hour. That's better than the .45 to .46 of the Lycoming gasoline engine and if it's accurate, it's comparable to the .36 to .38 of the Austro and Thielert engines. We're somewhat skeptical of the SMA claims because Austro and Thielert get their numbers with more sophisticated, FADEC-controlled fueling.

But even if the fuel specifics are that low, the SR305 does offer weight

continued on page 32

MORE DIESEL: CONTINENTAL AND RED

Could it be that what will really ignite diesel sales is a 300-HP or larger engine? If that's true, that's where Continental seems to be going. Two years ago, it bought from SMA the rights to use the basic SR305 as a technological seed for its own diesel program. It expects to certify the TD300 (200 to 250 HP) later this year and to follow that with the TD450, a 300- to 350-HP version of the engine that would add a couple of cylinders. Moreover, Continental's deal with SMA, as we understand it, doesn't constrain it from advancing the engine to include different turbocharging, fuel systems or induction.

Given that both Continental and Cirrus are owned by the same Chinese parent, AVIC International, it's reasonable to conclude that we'll see a diesel SR22 within a couple of years, if not sooner. Surprisingly, Continental is exploring the other end of the power spectrum, too, with a 160- to 180-HP TD220. That's a little light on power for the SR20, but might be suitable for new airframes of the Cessna 172 or Piper PA-28 class. Or Continental may have retrofits in mind, since it announced at AirVenture that it will pursue STC diesel conversions for the 182, just as SMA did shortly after it launched the SR305 in 1998.

One stunner at AirVenture was the appearance of the 500-HP V-12 Raikhlin diesel, which we saw in Europe during the Aero exposition. The engine is a bit of a modernized offshoot of the Rolls-Royce Merlin, with dual overhead camshafts, water cooling, FADEC direct injection and a gear reduction box. A six-cylinder version of the engine is planned. The V-12 is flying in a Yak 52 and Raikhlin—RED for short—sees a market in twins, high-perfomance singles and warbirds.

Although the engine has, at .62HP/lb., good power specifics, it has the same problem all high output diesels do: high absolute weight. At 800 pounds, it would be the heaviest of the diesels. Claimed best economy is an impressive .33 BSFC. RED hopes to certify the engine this year for production next year. For more, see www.red-aircraft.com.

Dynon D1 Pocket EFIS: Affordable Backup

Stick it in an empty instrument hole or on a suction mount and off you go. Internal battery and built-in GPS are plusses.

by Paul Bertorelli

When Dynon surged into the lead for uncertified EFIS systems with the D100, D180 and later the Skyview, we knew it was only a question of time before they stuffed that technology into a portable. So it was no surprise that the D1 Pocket Panel appeared just ahead of AirVenture. If this gadget works as well for others as it did for us, we have little doubt it will become a good choice for owners seeking backups for their creaky vacuum instruments. Dynon has cleverly packaged the D1 so as to be not mistaken for anything even suggesting a permanent mount. That should avoid any eruptions from the odd rogue FSDO inspector.

Dynon's D1 has a genuine MEMS solid-state gyro system for pitch and roll indications. Since it has no air data access, speed and altitude are GPS derived through a built-in receiver. Similarly, the heading indicator is also GPS ground track, not magnetic heading. The D1 has a remote antenna, but doesn't seem to need it.

EFIS WITH LIMITS

To keep things simple and avoid any entanglements—legal, electrical and pneumatic—the D1 is a trick combination of real EFIS and the sort of GPS-aided flight display Garmin has been including in its portable GPS products for more than a decade.

For pitch and roll sensing, the D1 has a MEMS solid-state gyro system just like full-scale EFISs. Lacking any airdata input, however, its airspeed, altitude, vertical rate and heading indicator are GPS derived. So altitude is really GPS altitude, speed is groundspeed and heading is GPS groundtrack. None of this is a deal breaker, in our view, because all you really want a backup gyro to do is to help you keep the wings level and the pitch manageable. The D1 does this easily; the additional data is gravy.

The hardware consists of a 3.5 by 3.2 bezel box that's just shy of an inch deep. The screen consumes most of that real estate, so it's about as large as the certified glass gyros you see in jets and turboprops. It has female sockets for external GPS, power—including charging via USB—and an SD data card for software revisions.

For mounting, Dynon provides a cradle that mates to a RAM suction cup mount and there's also a device called a "pinch" mount that allows the D1 to snap into an empty instrument hole while remaining an easily removable portable. It stands proud of the panel so you can attach the ship's power or GPS antenna, if needed. (We didn't need it.)

FLIGHT TRIAL

In what might be the world's first glass-panel, no-electrical system J-3 Cub, we stuck the suction cup on the window and went flying. The first challenge—and it's hardly worthy of the word—is to get the D1 calibrated so it knows it's not on the ground in level pitch. The device has a small rocker switch on the side of the bezel to nudge the horizon line in the right direction, which you have to do more or less by eyeball.

Dynon says the D1's software can accommodate up to 30 degrees of pitch error, but only 6 degrees of roll

error. Its side-to-side axis has to be as close to perpendicular to the longitudinal axis of the aircraft as possible in order for the slip/skid indicator to work correctly and to get reasonably accurate turn-rate indications.

We were fast and loose with the installation and found the D1 calibrated itself with no fuss. We switched it off and re-initialized in flight with similar success. Because of its sluggish speed and lack of a precision altimeter, finessing the pitch in a Cub with the D1 is measuring with a laser and cutting with an axe. But it's more than adequate to keep the airplane upright.

Screen brightness is good enough for a sun-splashed cockpit, although not quite up to big EFIS standards. Plugging the D1 into external power doesn't seem to help the brightness much. For night flight, the display can be dimmed in steps with the side rocker switch.

Dynon says the D1's rate limit is 150 degrees per second in any axis. We weren't about to exceed this in flight, but in handling the device for mounting or inspection, we noted that a "horizon recovering" rate-limit warning appeared along the lower edge of the screen. Righting the D1 back toward level pitch and roll clears this message.

The D1 has a slip/skid ball that more or less conformed to what the Cub's ball was indicating, which isn't saying much since it often sticks in the glass tube. The D1's heading indicator rotates in arc format and a magenta turn rate arc projects in the direction of the turn.

Obviously, measuring turn also involves yaw rate calculations so when the airplane wallows in the bumps, the D1 will show turn rate. It's also a little oversensitive when rolling into a turn, but we think the rate indicator is just an unnecessary whistle for a backup device anyway.

Our only complaint about the D1 is its menu key. It simply didn't work. The menu key is supposed to allow you to change units from knots to MPH or KPH, for example, and to set power-off and other preferences. We didn't have time to get another unit from Dynon, but we're taking the company's word that this feature works correctly in properly functioning units.

In a taildragger like the J-3, the D1's horizon line, right, has to be adjusted to account for the tail-low ramp position. That's done with the small rocker switch on the right side of the bezel, lower photo. Roll errors can also be cancelled with the same control. The D1's internal battery has a four-hour endurance, but it also has a ship's power option.

CONCLUSION

The dysfunctional menu key notwithstanding, the D1 performed as claimed. It clearly knows which way is up and displays and reacts to aircraft movements just as a full-blown EFIS does. The display is bright and easy to read, although the airspeed and altitude typography is on the small side. You'll need to mount the D1 in direct view to allow for that.

At $1425, the D1 is a good value, but it also has intense—and increasing—competition from tablet-based products. Its principle advantage is that it's small, self-contained and always on duty, so finding a practical spot for it on the panel will be easier than for a tablet computer. For more, contact Dynon at www.dynon.com.

TV D1 VIDEO

AVweb

http://snipurl.com/24kkhlx

The D1 has two mounting options, the suction-cup mount, below, and the pinch mount, top, which allows non-permanent mounting in a blank instrument hole. External GPS antenna and ship's power are included.

Interior Shop Survey: A Big Drop in Activity

The biggest surprise in our latest survey wasn't which shops soared or soured, but how much less work is happening at all. DIY interiors are also on the rise.

by Jeff Van West

Discretionary spending is one of the first casualties of tougher times, so we expected a drop in responses to our latest survey on interior shops. When you need a new engine, you pony up. But the airplane still flies with threadbare seats and cracked vinyl. You can tough it out.

But this mineshaft canary survey surprised us. In 2008, we got 209 responses—not an overwhelming number, but enough to see some trends and make some solid recommendations. This time we got 132 responses. That's a 37-percent drop, which is much more significant than we've seen on other surveys past to present.

We also noticed a sharp rise in the number of do-it-yourself jobs. In 2008, six percent of the respondents bought kits from Airtex or reported some other DIY interior. This time, 10 percent had bought Airtex interiors, and that number climbs to 16 percent if you lump together those using Airtex kits with several folks who removed parts, brought them to a local auto upholstery shop and then reinstalled them. (Yes, you can do this. See the sidebar on page 13 for some more insights.)

Interior projects have lots of moving parts—literally. Find a shop that has experience with your model, if possible, so they already know the trouble spots.

The good news is that most owners had a positive experience. Shops generally hit their cost estimates close or right on (77 percent) and finished on time (60 percent). A full 63 percent of owners would recommend the shop they used to a friend.

On the other end of the spectrum, seven percent of the jobs went 20 percent over budget or more, 12 percent were three weeks later or worse and eight percent would "no way" recommend the shop.

HOW MUCH WILL IT COST?

More good news is that prices haven't moved—or have even dropped—over the past four years.

Prices for interior jobs can't be easily averaged out because some folks are just recovering a pair of seats while others are stripping the interior bare, installing sound deadening and building it back up with fine leather and custom-dyed trim. The majority of owners were doing some combination of a full redo on all seats and carpet, plus interior trim as needed. The average price for a single was $11,490, but a few high-end jobs skew that number. The median paid—the number that approximates the most common response—was $8500, which is $500 less than our 2008 data.

Digging deeper, the data fell into some general groups. The king of the budget jobs was a Cessna 150 owner who had a local upholsterer do his seats, as well as supply the materials for the carpet and headliner. Total not including owner labor: $700.

Two professional jobs at Renew Aviation sounded like good buys to us. A Cessna Cutlass saw "complete removal of the existing interior; seat frames stripped, primed and painted; seat hardware replaced as necessary; seats rebuilt with different density, temperature-sensitive foam with deeper contours; custom headrests built and installed; new sidewalls, kickpanels, door panels and carpet; and the original Cessna Royalite refurbished or replaced as necessary." The final bill was the promised $4000. A similar $7500 job on a 210 from Renew was delivered under-budget and early.

There was a fat middle of $10,000-$15,000 jobs on singles where full interiors were combined with sound deadening and some new windows.

Sound deadening is a tricky item. It provides terrific benefits on some craft and little gain on others. It always adds weight—more than necessary if not done right. This is one place to talk to several shops and, if possible, owners of like types who've had similar work done.

There were several jobs where serious customization skyrocketed the price. A Cessna 182RG done at the well-known shop Airmod saw "restoration inclusive of corrosion proofing, sound insulation, full interior renovation including seatback build up (eliminating the need for adjustable headrests), customized seating foam, seat-frame restoration, glareshield, all interior plastics, panel overlays, carpeting, overhead, custom heat outlets, custom seat belts and more." The invoice weighed in at $22,000.

Was it worth it? According to the owner: "Every hour of time you spend sitting in a seat that is sculpted to your personal needs is a payback for your foresight." Not everything through Airmod was pricey. They did a full interior on a Cessna 182 without fancy customization for a quite reasonable $6000.

Twins usually cost more just by the size of the cabin. Our survey showed an average and a median of $22,500, with machines ranging from a Twin Comanche to a Citation.

SHOP CHOICES

If you're not doing the work yourself, you have a quite a range of choices when it comes to who does the work. At least two of the Airtex interiors reported in our survey ended up being installed by a local A&P. One was planned to happen that way and one was a decision made after seeing the reality of the Airtex kit.

Some shops will do the work remotely. One Mooney 231 owner shipped her seats and panels off to AeroComfort in Texas. "They completed the job, despite the December rush, ahead of schedule. When I returned to collect my new interior and the signed-off airplane wrapped around it, I was overwhelmed. The workmanship and sheer artistry far exceeded my expectations. So elegant! So comfortable, and somehow so perfectly fitted to my shape that I dispensed with my two-inch, see-over-the-nose seat cushion."

CUSTOMERS' FAVORITE SHOPS

With lower response numbers, we can't apply our previous minimum of five reports to recommend a top shop (except for Airmod, who always makes the cut). These shops got top marks and "absolutely" status on a recommendation, but many were from only a single report.

SHOP	LOCATION	CONTACT
AERO DESIGN CONCEPTS	WESTFIELD, MA	413-568-7300 WWW.AERODESIGNCONCEPTS.COM
AEROCOMFORT	SAN ANTONIO, TX	210-340-0177 WWW.AEROCOMFORT.COM
AEROSPORT PRODUCTS	CANAL WINCHESTER,OH	614-834-8659 WWW.AEROSPORTPRODUCTS.COM
AEROWEST INTERIORS	HOUSTON, TX	281-398-3821
AVIATION DESIGN	GROVELAND, CA	800-752-4297 WWW.AVIATIONDESIGN.COM
AIRMOD	BATAVIA, OH	513-732-6688 WWW.AIRMOD.COM
ARTCRAFT	SANTA MARIA, CA	805-925-5934 WWW.ARTCRAFTPAINT.COM
BELLARDI INTERIORS	WATSONVILLE, CA	831-724-0619
CROTT'S AIRCRAFT SERVICE	DODGE CITY, KS	800-475-3553 WWW.CROTTSAIRCRAFT.COM
GIOTTO'S AIRCRAFT INTERIORS	SAN JOSE, CA	408-286-4500
HIGHLANDS AVIATION	AVON PARK, FL	863-452-2600
INTERIORS UNLIMITED	OKLAHOMA CITY, OK	405-787-1132 WWW.INTERIORSUNLIMITEDINC.COM
LEATHER SPECIALTIES	GEORGETOWN, TX	512-863-3500 WWW.LEATHERSPECIALTIES.NET
O&N AIRCRAFT MODIFICATIONS	FACTORYVILLE, PA	570-945-3769 WWW.ONAIRCRAFT.COM
OHIO AIRCRAFT INTERIORS	ZANESVILLE, OH	740-452-1636
OREGON AERO	SCAPOOSE, OR	800-888-6910 WWW.OREGONAERO.COM
OXFORD AVIATION	OXFORD, ME	207-539-4779 WWW.OXFORDAVIATION.COM
RENEW AIRCRAFT	CLEVELAND, OK	918-358-0041
RON KOZURA UPHOLSTERY	POTTSVILLE, PA	570-544-6723
TEJAS AERO SERVICES	SAN MARCOS, TX	512-392-8553 WWW.TEJASAERO.COM
YINGLING AVIATION	WICHITA, KS	800-835-0083 WWW.YINGLINGAVIATION.COM

Many owners reinforced the fact investing extra time up front to clarify exactly what you want before any cloth is cut is time well spent. This 210 owner's thoughts were typical: "I had met with other shops and received samples, so I knew what I was looking for. Providing pictures or drawings will also help the shop understand what you want and keep the costs down."

Good advice doesn't have to be from a big shop, but airplane knowledge helps. This Cherokee Six owner had his work done by Kozura Upholstery. "He is small in volume, and probably does more trucks than airplanes. I know that seems odd, but he knows his stuff, being a pilot himself."

Be prepared for expenses beyond the interior work when you pull everything out. It's almost an imperative to have someone check the bare interior for needed repairs when it's all exposed. This could be the first time it's seen daylight since being sealed up on the factory line 30 years ago. Corrosion issues are common, as are frayed wires that could pose a fire risk. Some issues are typical for certain types. Broken drift pins on seat tracks and track wear are common on Cessnas. This is where a shop that's done many examples of your specific make and model can be a real boon.

It's also tempting to do paint or major avionics work along with the interior. Hey, the aircraft is going to be down for several weeks, why not make the most if it?

This is generally a bad idea, especially if you're dealing with a smaller shop or multiple shops. If one part of the project gets delayed—additional rewiring for avionics is needed or a part doesn't arrive—the carefully coordinated schedule is toast. If your interior-free airplane can't be tugged over to the paint shop on the appointed day, they may push your project to the back of the line. That's when the deal starts to go south.

Here's a reason for a new interior that might be on the rise: Li-ion battery fire. Randy Bliss says the completely redone cabin came back without a trace of burnt-vinyl smell, and his only complaint was a couple of radios weren't internally cleaned as much as they needed. Total bill: $42,000.

THAT AIN'T RIGHT

Surveys always turn up some horror stories. Said one Bonanza owner of a job: "His installer caused over $5500 in damage to my aircraft, some irreparable and some safety of flight."

A Debonair owner had a nasty surprise on preflight: "The aircraft was delivered to me with elevator travel blocked from neutral to full nose up. Had I attempted take off, the aircraft would not have rotated. I still get chills thinking about it. In rectifying the elevator problem, the nose gear up/down flag adjustment was disturbed resulting in gear-up flag out of adjustment."

These issues probably distracted the owner from discovering that the screws for the pilot-side headset jacks were improperly placed and pulling out. To the shop's credit, the shop owner traveled to the Debonair owner's home base to fix the problem at no charge.

We received a well-documented case of a Cessna 210 that went in to Evolution Aerostyling in April of 2010 and finally emerged in August of that year—four months past due.

The shop appeared to go dark three weeks before delivery, not responding to email or phone calls. When the owner finally got into the shop, he found it a mess and his airplane in pieces. He considered getting the local authorities involved so he could tow away his dismantled

A thorough inspection at delivery is critical. This poorly installed headset jack wasn't noticed until after the 1200-mile trip home.

airplane and materials he paid for and cut his losses.

In the end, the job was completed and Evolution paid a $4000 penalty assessed off the $20,000 bill as compensation for the delay. There had been a clause specifying penalties for late delivery in the original contract at the owner's demand.

We talked with Evolution's owner Eric Hockman about what happened. He explained that they had just started specializing in 210s and offering their own headliners with LED lighting and custom ventilation. "We were just overwhelmed by what it was taking to put the interiors in," he said. "It was not a shining moment for the shop."

Hockman says he's cut the number of aircraft he does each year and changed procedures so this won't recur. "I'd much rather do less work and good work and get it done on time. I do a lot of custom work that most shops don't want to do."

We don't think one bad customer experience should condemn any shop. This survey, like previous ones, turned up a couple of negative experiences amidst a field of positive ones for even the best shops, such as Airmod. The takeaway is that problems can happen anywhere, and communication is the key to keeping the shop-owner relationship on the rails. Visiting the shop before you hand over a deposit is highly recommended. A late penalty in the contract isn't such a bad idea either, though.

OLD SEATS = LESS USE?

Interiors are a funny thing. You don't think about them that much, even though they may have as big an impact on your flying experience as any other aspect of your aircraft. We wonder if there will be some unwanted consequences of a drop in refurbishment projects.

It seems one of the owners in our survey thinks likewise: "If your backside aches after three hours in the saddle, you'll find yourself not wanting to take that cross-country flight, thereby denying yourself and your family of one of the most special aspects of ownership. Get the best interior installed by a top shop, and then use it often."

DIY: A POPULAR OPTION BUT WITH ITS OWN ISSUES

We talked with Dodd Stretch, President of Airtex, to get a feel for how he's seen his business change over the past several years. He said that business hit a low point in 2008, but has been on the climb since then. He's looking to bring the staff up from 20 to 23 just to handle current orders. "This year is probably 12 percent over last year. Oshkosh was 30 percent over my goals."

We reported on Airtex in our August 2009 issue, but just to sum up: They've been in the business for 64 years and, according to Stretch, "If something was made on a production line, we probably have a pattern." Stretch says their biggest complaint was that their look hadn't been updated to match modern styling.

In response, Airtex has introduced new styles and new materials they think are competitive with what you see from custom shops. Kits for four-seat singles usually run $3000-$4000 for seats, carpets, headliner and panels. Airtex also offers complete refurbishment at their New Jersey shop. Stretch says that shop is booked six months out. Custom work can be ordered with kits as well, with any increase in cost proportional to how complex the customization.

Some of our survey respondents gave us their take on installing Airtex kits. A Cherokee 180 owner said, "Plan on the plane being down a while. Mine took approximately 120 hours to complete. There were other parts that needed replacement along the way." Another owner put it more simply: "Be prepared to sweat. It is a lot of hard work."

Stretch and owners both agreed that taking a lot of pictures during the teardown is a good idea, so you know where every screw, nut and bolt goes. Stretch also stressed getting an A&P to inspect the bare interior before you put the new stuff in.

Some of the owners who worked with a local upholstery shop beat the Airtex kit prices, but Stretch noted two caution areas here that he sees come back to haunt owners. One is that every material—cloth, foam, slings, carpet—must have burn-test documentation, either directly in the aircraft logs or by reference to where the documentation exists. The other is that design changes such as cushier seats must not interfere with things like doors closing or flap handles being accessible.

As for how hard the kits are to install, Stretch points out that there are no instructions sent with them, yet they only get tech support calls on about five percent of sales. "I wish it was higher," says Stretch. "There are a lot of tricks to making it look right, and the better it looks for the owner, the better it reflects on our product."

Garmin's ADS-B WX: One Box Amidst Many

Garmin's GDL 39 receiver for ADS-B weather and traffic works well. However, it's not the smallest or cheapest, nor does it play with the most popular apps.

by Jeff Van West

One of the things about Garmin that continues to impress us is how its maintained its entrepreneurial edge despite being the colossus occupying most of the avionics space these days.

The iPad challenged Garmin in the portable world, however, and it was slow to respond. Respond it has, with a strong iPad app of its own and now a portable ADS-B receiver for both traffic and weather. However, the GDL 39 receiver has hard competition in this arena and, from where we sit, it appears the competition's entrepreneurial edge is sharper than Garmin's.

BIG BOX SOLUTION

The GDL 39 is robust in more ways than one. It's a solid performer, starting up fast and picking up ADS-B ground stations as soon or sooner than any of the systems we've tried. As you'd imagine from a Garmin product, the GPS is built in.

Reception was flawless on our test trip from Portland, Maine, to Oshkosh, Wisconsin, paired to both a Garmin 796 aera and an iPad. While we didn't test it, the GDL 39 can pair with two devices via Bluetooth and one via a cable all at once. The aera currently requires the cable, but the 796 has Bluetooth built in and will connect wirelessly in the future.

The GDL 39 is also big. The unit is about the size of a sardine can, and the optional battery almost doubles that size. This is noticeably larger than the popular Stratus and could be a shipping box for a pair of Sagetech or Dual ADS-B receivers. The GDL 39 is $799, but that's without the battery. You'll need to pay an extra $100 for that feature.

Garmin's GDL 39 is big—especially with the battery. It only connects to the Garmin Pilot on the iPad, but can bring ADS-B weather and traffic to Garmin GPS portables.

ADS-B weather is well integrated into the Garmin Pilot iPad app. The app downloads weather via the internet before your flight and, when paired with the GDL 39, ADS-B weather replaces the downloaded stuff as it comes in. You'll find METARs, TAFs and NOTAMs in the same place as the internet-derived stuff, with a timestamp and a source so you know what came from where. The aera works similarly, except the free ADS-B stuff replaces what you'd get via XM.

We should point out that what a GDL 39 will do varies with the application. The iPad app will do full weather and traffic with trend vectors. The aeras, G3X and GPSMAP 696 will do weather and traffic. The GPSMAP 496/396 will do traffic, but you'll still need to get your weather via XM. Only the 796 and iPad can get away without a cable connection.

We've pointed out before that ADS-B weather has limitations compared to XM. The biggest is that you usually can't receive it until you're airborne and for mountainous regions, that might require some serious altitude. There are fewer weather products, although all the critical ones are there. Garmin's Pilot app has an additional limitation compared to ForeFlight, WingX and several other apps: It can't simultaneously display NEXRAD and other weather data such as METARs. You must choose one or the other.

ADS-B TRAFFIC?

The prospect of free traffic data sounds terrific, but the reality will be a gross disappoint for most people today. ADS-B weather is simple: It's broadcast by the FAA from ground stations on a frequency of 978 MHz with complete data for airports and weather several hundred miles around the sending station. There's also a low-res NEXRAD image for the whole country.

Traffic is different. First off, there are two frequencies, 978 MHz and 1090 MHz. The GDL 39 listens on

The "big things in small packages" award goes to Sagetech's Clarity. It's the smallest, but offers optional dual-band traffic and a backup AHRS in addition to weather.

both. Aircraft with an ADS-B-Out transponder broadcast on one of these frequencies. So if there's one of these nearby your position, the GDL 39 will see it and paint the target on your screen. In fact, it will paint it complete with an N-number, relative altitude and trend vector.

FAA ground stations also listen for these ADS-B aircraft. If they detect one, they build a custom information packet with data on all traffic in the airspace immediately around that aircraft. This includes both ADS-B-equipped traffic and aircraft with regular transponders. That data is broadcast directionally to the ADS-B-Out aircraft it's intended for. Your GDL 39 will hear these broadcasts (if it's in range) and paint a blob of traffic on the map centered on that other ADS-B aircraft.

The result is that—if you don't have your own ADS-B-Out transponder—you see seemingly random blobs of traffic, sometimes hundreds of miles away, but won't see non-ADS-B-equipped traffic even if it's at your 12 o'clock and two miles. (Unless you, you know, look outside.)

We think this kind of solution is next to useless—possibly worse than useless as it could foster false security. If you have an ADS-B out transponder, it's a completely different story because the FAA ground station will send you a traffic data blob centered on your aircraft. So this could be a good way to display traffic once you have your own ADS-B-Out transponder.

Just for the record: A GDL 39 does not count as ADS-B compliance.

WHEN ADS-B ISN'T ENOUGH

Garmin's GDL 39 became public around Oshkosh with the accompanying power of Garmin's media en-

	SAGETECH CLARITY CORE	SAGETECH CLARITY DUAL SV	GARMIN GDL 39	NAVWORX PADS WXBOX	SKYRADAR L	SKYRADAR D	SPORTY'S STRATUS	DUAL XGPS170
SIZE	2.5 X 2.5 X 1.1	2.5 X 2.5 X 1.1	6 X 3.5 X 1.9	4.3 X 4.3 X 1.3	6.3 X 3 X 1	6.3 X 3 X 1	5.8 X 4.3 X 1	4.3 X 2.6 X 0.8
978 MHZ WEATHER	YES	YES	YES	YES	YES	YES	YES	YES
978 MHZ TRAFFIC	YES	YES	YES	-	YES	YES	-	YES
1090 MHZ TRAFFIC	-	YES	YES	-	-	YES	-	-
WIRELESS SYSTEM[1]	WIFI	WIFI	BLUETOOTH	-	WIFI	WIFI	WIFI	BLUETOOTH
INTERNAL BATTERY	YES	YES	OPTIONAL [2]	OPTIONAL	-	-	YES	YES
INTERNAL GPS	YES	YES	YES	-	YES	-	YES	YES
AHRS	YES	YES	-	-	-	-	-	-
IPAD	WINGX, i1000, GLOBAL NAV SOURCE	WINGX, i1000, GLOBAL NAV SOURCE	GARMIN PILOT	-	WINGX, SKYRADAR	WINGX, SKYRADAR	FOREFLIGHT	WINGX, GLOBAL NAV SOURCE, i1000, READER PLATES
OTHER HARDWARE	MOUNTAIN SCOPE, XTREME VISION	MOUNTAIN SCOPE, XTREME VISION	AERA, SOME GPSMAPS, G3X	XTREME VISON, IFLY GPS, ESSENTIAL FLIGHT TABLETPC	IFLY, MOUNTAIN SCOPE	IFLY, MOUNTAIN SCOPE	-	-
PRICE	$699	$1,117	$799	$849	$599	$849	$799	$799

1: ALL SYSTEMS CAN MAKE AT LEAST TWO SIMULTANEOUS WIRELESS CONNECTIONS. 2: WITH BATTERY 6.4 X 3.8 X 2.8

Garmin is honest that without an ADS-B-Out transponder, the ADS-B traffic picture around your aircraft may be incomplete. ADS-B weather is also more limited than satellite weather.

gine. At the same show, a company that had long specialized in avionics for drone aircraft appeared with four tiny ADS-B receivers that do everything the GDL 39 does and more.

Sagetech's Clarity series stand shoulder high to a stack of crackers and come with weather, single- or dual-frequency traffic and an AHRS (digital gyros). The ARHS combined with the internal GPS lets the Clarity offer a synthetic vision to serve as emergency flight instrumentation or just great situational awareness in the clouds. We have yet to fly the Clarity with synthetic vision, but the response and display was supersmooth when we toyed with it at Oshkosh.

Sagetech also touts its "data burst" feature that will continue to download and buffer data even if the iPad sleeps, streaming it all at once when the iPad wakes so there's no wait to get fresh data. We have yet to try this ourselves.

The price is right as well. The closest equivalent to the Garmin GDL 39 would be the Clarity Dual (both traffic frequencies) without the AHRS, which is $877, but the battery is standard.

Clarity has no visible antennas at all, and we have yet to see how well it receives in flight. It's worth noting that internal antennas are both a blessing and a curse. These devices can get quite hot sitting on the glareshield and can shut down if they overheat—kudos to Sagetech for making their box a reflective white rather than the omnipresent black. Stowing your receiver under a seat with a remote antenna system for ADS-B and GPS reception can be a plus.

Sagetech isn't the only newcomer to a crowded field. Dual has its compact XGPS170 coming out this month. FreeFlight systems also has a remote box that gets installed in the aircraft as part of a permanent ADS-B solution that outputs to the iPad for a display on the cheap. We can't see how the market can sustain even this many options, and we expect this isn't even the end of it.

TV GDL 39 ADS-B

AVweb

http://snipurl.com/24l0qz3

HOW TO PICK?

If you're trying to pick, the decision may rest on software you want to use for display. Garmin's GDL 39 only works with Garmin portables, the G3X panel for experimental aircraft and Garmin's pilot app. It's worth noting that Pilot plays on both iOS and Android and the GDL will connect with Android devices.

The most popular cockpit app is ForeFlight, but right now it only supports Stratus—not surprising as ForeFlight is part of the group that developed and produces Stratus. Stratus does not do traffic, but until you have an ADS-B-Out transponder, we don't see this as a real liability. Several of these devices work with WingX, so if WingX is your tool of choice, you have options.

There's no question these devices will be part of our cockpits for the foreseeable future, and have no reservations about the GDL 39 if you want weather for your Garmin products and have a place to put it.

CONTACTS

Dual 866-382-5476 www.dualav.com	Sagetech 509-493-0171 www.sagetechcorp.com
Garmin www.garmin.com 800-800-1020	SkyRadar 888-759-2372 www.skyradar.net
NavWorx 888-628-9679 www.navworx.com	Sporty's 800-766-7897 www.sportys.com

Cabin Sunshields: Kennon is a Top Pick

Shades from Kennon keep the sun out with an accurate fit. Sun-Foil brings durability and good looks.

by Larry Anglisano

CHECKLIST

- Shields are an inexpensive tool to protect the cabin from sun damage.
- Stowage can be a space-eating hassle, taking up baggage space.
- Cabin covers offer better overall protection, but with more weight and bulk.

Protecting your cabin and pricey electronics from damaging ultraviolet rays should be a priority. If your aircraft lives outside, chances are you've invested in a cabin cover, but you might not use it for short parking stays on transient ramps. Cabin window sunscreens can be a good alternative. They'll reduce cabin heat while keeping the sun from frying avionics, cabin accessories and interior components while also deterring theft.

We judge sunscreens on three primary traits: Fit, durability and ease of storage. When they fit properly, they keep the sun out and reduce cabin heat. Good durability means they'll continue to fit properly and stay in one piece after repeated manhandling and sloppy stowage. And, they need to be stowable with ease. All the brands we tested in this article were effective at lowering cabin temperatures while doing an adequate job of keeping damaging sun out of the cabin. But we strongly favored a couple of brands for bringing exceptional fit and build quality

DAMAGE DONE

We once learned about cabin sun damage when we parked an airplane on a South Carolina ramp for a week in August. Not only did the blazing southern sun melt the earseals on our headsets, it also finished off the gasket that retains the messy fluid inside the wet compass. Just as sun exposure is damaging to the human skin, it also does a number on aircraft cabin accessories. That includes panel and portable avionics, interior plastics and fabric. Sun exposure dries out the adhesive that's used to secure interior components. It also dries out door seals, window gaskets and cracks the surface of the glareshield. If you leave

Insulating sunshields like these Sun-Foils are designed to deflect damaging rays while reducing cabin temperature.

HOW HOT?

Part of our testing included the temperature analysis of partial shielding, full shielding and no shields at all. Without shields, a 90-degree sun-soaked ramp created cabin temperatures of 150 degrees on average.

A full set of shields lowered readings to around 120 degrees. But in covering just the windscreen, we measured readings as high as 135 degrees.

We concluded that most of the heat is created by an uncovered windscreen, leaving the surface of the glareshield and avionics the most vulnerable to damage. So if you find your shields living most of their life in the baggage compartment because climbing around the cabin to install them in all the windows is a hassle, we think covering at least the windscreen will still do an adequate job of lowering cabin temperature.

portable electronics in the aircraft as most of us do they'll take a beating. The good news is that modern aircraft glass is made of cell-cast, acrylic plastic that does well in absorbing some UV. However, interior shops have told us that UV will fade upholstery and degrade the fabric.

Many TSO'd radios are designed to operate at around 160 degrees Fahrenheit—a temperature that might be exceeded in a sun-scorched cabin. This can compromise long-term reliability because displays, integrated circuits and other small components are at risk.

Our test aircraft was a Piper Arrow that's parked outside and in direct shot of baking mid-summer sun. First, we measured unshielded cabin temperatures over a three-day period that happened to occur during an official heat wave with near 100-degree temperatures. We saw cabin temperatures in the 145- to 155-degree range. Installing every shield we tested reduced the temperature by at least 25 degrees.

Testing in the Piper and other aircraft models including a Cirrus and Cessna revealed that a good fit and easy installation will be difficult to achieve no matter the design of the shield. That's because in most aircraft you'll battle awkwardly hung wet compasses, visors, bulky glareshields, vent windows and a crammed cabin that doesn't favor working with large shields. Speaking of crammed, storing these things in a tight baggage compartment can be easier said than done. They need to be flexible enough to fold without damaging them. All samples arrived inside drawstring storage bags.

Our testing considered the shields flexibility—the ability to bend, fold, scrunch and maneuver inside tight cabins —and especially the ease of getting them back into the storage bag. From a design standpoint, you wouldn't want a shield to scratch your acrylic glass, so it has to be soft yet durable. We tested this carefully against the surface of the acrylic glass.

KENNON COVERS

Cabin cover maker Kennon has bragging rights for developing and supplying cabin shields to military aircraft around the world. The shields are designed with a clear, polyester coating with a soft Sunbrella edge that helps prevent window scratching.

Kennon says their shields reflect 93 percent of the infrared rays back through the windows before they are absorbed and produce heat. The aluminum surface of the shields acts as a good reflector. You can easily see the sun bouncing off the surface.

The Kennon product offered the most accurate fit of any in the sample group. There was no need for suction cups or other means of fastening in the Piper and in a Cessna 206 we tested. That's likely because these shields are computer cut. We were able to easily and quickly slap them in place on all the windows in the Piper and noted a near exact fit—something none of the other shields offered.

Our experience seems to be common. We heard favorable comments from nearly every Kennon shade user we queried. The corporate pilot of a Piper Cheyenne told us the aircraft's Kennon shades are a valuable part of his ramp operations—and a far better alternative to draping VFR sectional charts across the glareshield to keep the sun out.

Further, he told us they do a good job of keeping the cabin heat at a minimum so that the air conditioning is more efficient once picky passengers climb aboard. They've also done a decent job of protecting the

Cheyenne's posh interior. A full set of shields for our Arrow cost $195.

SUN-FOIL

Sun-Foil's Aircraft Sunscreens are made from hand-rolled gold or silver-colored Mylar laminate, which the company says provides additional glass protection, rigidity and durability. We found the claim to be true. They're also designed to reflect 97 percent of radiant heat. These shields were the thickest and most rugged in the group.

Further, they were the only ones that use a combination of suction cups and friction fit design to help keep them in place. In fact, when we tried to remove the shields in a hurry, we found the suction cups to be almost too aggressive. Where other shields wiggled and dropped slightly out of place, the Sun-Foils kept a solid grip. The shields were easy to roll together for storage and secure with a long Velcro strap.

We found them easy to drop into the storage bag that comes with a customized aircraft identification tag—a nice touch. Another nice touch was the gold coloring on the outer surface of the shields. Several ramp-dwellers commented on the shields' good looks and we concur. Sun-Foil uses a double-stitched edging to aid in scratch protection and the company offers a lifetime guarantee on the shields workmanship. If you lose any suction cups, they'll replace them as needed. You'll find Sun-Foil as OEM-supplied accessories in some Cessna, Bombardier, Gulfstream and Pilatus models. A full set of shields for most singles and light twins cost between $225 and $350 for jets and turboprops.

Packable shades are light enough but create sizeable bulk in the baggage and cabin area.

GROW YOUR OWN

For would-be do-it-yourselfers, Sporty's sells sheets of insulating material sandwiched between thin sheets of aluminum. The material sells for $15.95 per yard plus Velcro mounting coins for attachment. However, this material can be damaging to acrylic windshields.

Sporty's—through Bruce's Custom Covers—offers custom made heat shields with attaching suction cups. Bruce's has a favorable track record with high-quality custom cabin covers. The heat shields are made from metallized polyester film and closed cell foam. We couldn't get a custom set in time for this review, but a full set will cost around $200. If you've used these shields, we'd like your feedback.

AVIATION COVERS

Aviation Covers purchased the manufacturing rights to Cunningham Aircraft Covers in 2006. We were impressed with the Cunninghams when we tested them in our Mooney in a previous review. But not so much with the samples received this time for our Piper.

While made to obvious high standards, the shields just didn't fit properly. The windshield pieces were too big and some of the window shades had a sloppy, oversized fit. It's likely that our samples were made for a different application even though we specified our test aircraft by year and serial number. To be fair, we placed our order just days before AirVenture Oshkosh when most companies

CONTACTS

Kennon Aircraft Covers
www.kennoncovers.com
307-674-6498

Sun-Foil Aircraft Sunscreens
www.sunfoil.com
602-569-9334

Aviation Covers, Inc.
www.aviationcovers.com
360-434-0342

Sporty's Pilot Shop
www.sportys.com
800-776-7897

are scrambling. Fitment troubles aside, we found that the shields were constructed well. They are made of a foil-covered, bubble insulation material with an outer coating of clear polyester that's intended to prevent scratching.

The edges of the shield are constructed with acrylic plastic. We liked the identification labels on the underside so you can tell which window they fit. The shields come with a drawstring bag that fought us when we tried to drop the shields inside. We just couldn't seem to roll them tightly enough to easily fit the bag.

We spoke to the owner of a Bonanza who uses the prior Cunningham shields and he reports good fit and durability. Aviation Covers shields sell for $225.

CONCLUSION

Our thanks go to Total Aircraft Maintenance in Hartford, who provided the aircraft for our testing. This seasoned shop and respected interior shops we spoke with advocate use of sun shades. That's because they've repaired enough sun-damaged interiors that could have been saved by sunshields or cabin covers. We think cabin covers offer the better solution because they tame water intrusion while protecting glass and antennas. But they're heavier, bulkier and might be more time-consuming to install than shields.

Our top pick for sunshields are the Kennons. They proved to have a superior fit and passed the long-term test for overall durability. But we also like the Sun-Foil screens. We think they are handsome, have a high-quality feel and are gentle on the glass. You wouldn't go wrong with either of the products.

Moreover, both companies were helpful and cooperative to deal with, a real plus in these days of minimal customer service.

Avidyne Plug and Play: Upgrades Made Easy

Avidyne's slide-and-fly radio stack answers the call for cost-effective upgrades. When will Bendix/King join this market trend?

by Larry Anglisano

Avidyne is targeting Garmin's customer base and simplifying installations with the CNS line of drop-in avionics that replace an entire Garmin stack. The core products include the IFD540 and IFD440 GPS navigators and can plug into existing GNS530 and 430 wiring. The concept of plug-and-play avionics is hardly revolutionary. In 1990, Michel Avionics' MX-series TKM radios came close to perfecting no-wiring upgrades. Radios that mated with the aircraft's existing wiring and mounting hardware became so popular that nearly 40,000 TKM navcomms were placed in service. This cheap alternative to costly avionics retrofit was later mimicked by now-defunct Narco Avionics.

We've always recognized the front-end cost benefits of slide-in replacement radios, but we've hardly embraced the technology. Simple as it is, old and potentially substandard wiring remains in place, leaving reliability issues unresolved. As Avidyne prepares to bring the CNS-series slide-ins to market, we took a fresh look at the concept and the dollar benefits that might support an owner decision. We think it might make sense for some buyers.

R9 TRICKLE DOWN

As we've reported since its introduction last year, Avidyne's retrofit IFD540 navigator and the recently announced smaller IFD440 are trickle downs from the Avidyne R9 integrated glass panel. R9 uses an advanced flight management and communications feature set that we think is a giant leap above the original Entegra suite. This glass panel was used in earlier Cirrus, Piper and limited aftermarket applications and the interface was primarily driven by Garmin GNS530 and 430 navigators. While the Garmin navigators did the job, owners were itching for something

If the Avidyne IFD series reminds you of updated Garmin GNS navigators, they're supposed to.

more advanced than the 1990s technology of the GNS430 and 530. The IFD navigators are Avidyne's answer and the ticket to a complete Avidyne navigation management interface. Of course, one option is to install Garmin's latest GTN-series touch navigators, but they have a more complex installation.

Avidyne set out to satisfy the demands of buyers who aren't completely sold on a primary navigator that uses a touchscreen. Garmin's new GTN boxes are commanded almost entirely by touch and have been well received, but there are some skeptics. For that crowd, Avidyne's IFD brings a hybrid control logic called Multi Touch. It offers the choice of using either capacitive touch and traditional knobs and buttons. With the IFD, anything you can perform with touch you can also perform using keys and knobs. Bezel controls are simple and rugged. If you come from a Garmin 430 or 530, the IFD will seem ultra-modern, as evident by the USB port on the upper left for loading software and navigational data.

If there's a single reason to upgrade from a GNS530 to the IFD, it might be to gain a superior VGA-quality display. The IFD540 display measures 5.7-inches diagonally on a touch LCD of 65,535 colors in 640x480 pixels. Check that against the stark GNS 530 series—it was designed with a 5-inch diagonal, eight-color 320x234 TFT LCD. For those looking for more advanced FMS functions, Avidyne carries over a feature that's been a big hit with the NMS system in the R9. It's called GeoFill. When entering and editing waypoints, GeoFill accurately guesses the next waypoint in a flight plan after only one or two characters are entered. The system is smart enough to know what waypoint you're looking for based on position

When it comes to chassis size, the IFD540 shares the same dimensions as the Garmin GNS 530 and the IFD440 clones the GNS430 footprint. These systems aren't just for drop-in retrofit. They can be purchased with installation kits for new installations. In that case, all bets are off for a low-cost installation. Expect a sizeable teardown and the associated costs.

The early-gen Cirrus above is one of Avidyne's target drop-in applications. Total stack replacement can be accomplished in a few hours, unlike the weeks-long project that's underway in the Cessna 310 in the lower photo.

CHECKLIST

- Drop-in equipment reduces upgrade down time to a matter of hours.
- Avidyne's IFD navigators have impressive capability evolved from the R9 glass cockpit.
- These products aren't available yet which makes early buy-in iffy.

REAL WORLD COSTS

Speaking of costs, we took a close look. Removing the 530W, installing and configuring the IFD540, performing a flight test and producing appropriate paperwork should require three to four hours. That's $300 to $400 of labor at most shops for a $17,500 total project with no disassembly required.

Consider a $16,995 Garmin GTN750. Since the GTN750 is larger than the GNS530, the radio stack will likely need to be removed, reconfigured and some radios may need to be relocated. The interface wiring will need to be modified since the GTN750 isn't plug and play with GNS530 wiring. These projects are averaging about three to five days which totals $3000 in labor for an average project whose total can top $21,000.

PAY NOW, DELIVER LATER

As we go to press, Avidyne is offering a sweet deal that might tempt Garmin GNS530 and 430 owners to purchase an IFD navigator at a discount. For the IFD540, the early buy-in is $10,000 compared to the regular price of $16,995 and for the IFD440, it's

BENDIX/KING: OVERDUE FOR DROP-INS

Michel Avionics once enjoyed brisk sales in part due to the venerable King KX170 navcomm and aging Cessna ARC RT300-series radios. The MX170 digital TKM radio answered demand for an easy upgrade from the world of drum-style mechanical tuning to the microprocessor-controlled digital frequency flip-flop feature set that came alive in the late 1980s.

While the technology is different, Bendix/King faces a similar opportunity now. That's because many aircraft still sport capable but dated stacks of Bendix/King Silver Crown radios. This includes KX155 navcomms, KNS80 area navigation computers and even analog, cavity-driven KT76 transponders. Then there are newer, non-G1000 Cessnas and select Piper models equipped with late-1990s vintage OEM Silver Crown Plus equipment. We think a new product line that can replace these dated, core products has a shot in today's market.

We went to this season's AirVenture expecting to see just that, but it doesn't exist yet. What we did see was the seed of a potential drop-in line with the new KMA30 audio panel. But it's more clone than an original product. The new audio panel isn't a Bendix/King design, but is instead a PS Engineering PM8000BT sporting a Bendix/King face plate.

This unit can drop into an existing Garmin GMA340 audio installation with no need to rewire. But loyal Bendix/King buyers we spoke to were expecting much more. These are some of the folks who bought into the Bendix/King KLN89 and KLN94 GPS navigators back in the late 1990s and early 2000s. It was around this time that Bendix/King was faced with bettering Garmin's newly introduced GNS430, but the R&D door seemed to close, beginning a long hiatus of product development and a withdrawal from the GA sector. Some disappointed buyers we spoke to during AirVenture voiced concern that Bendix/King missed the opportunity to regain a firm footing in the market. We'll counter by noting that Bendix/King has the engineering ability to bring drop-in replacements to market just as Avidyne has done. Bendix/King is a company with a heritage of introducing well-designed products. They also just announced a commitment to the GA market with plans to deliver the fresh products loyal customers say they want.

In our view, if they have any hope of surviving in a weak selling climate dominated by Garmin and second-place Avidyne, they'll need to get busy while they still have the attention of remaining loyal if skeptical would-be customers and dealers.

$8500 compared to $14,995. To get this reduced pricing you have to pony up in full right now, with the option of getting a full refund by AOPA Summit if you change your mind.

We've heard from dozens of potential and skeptical buyers who were reluctant to fork over that kind of cash for what they perceived as developmental products that might not be in their panel for a least a year (the IFD540 is expected early next year while the IFD440 could be over a year from release).

Using consumer deposit money to front the staggering costs of product development may be new to the avionics market, but it's a practice that's widespread in the airframe business. There are the rightful fears that the developing company might not be around a year from now. As for Avidyne, we have no reason to believe they won't be here to deliver the goods. They have a proven track record for bringing quality products to market and we think they are forward-looking. But only you can decide if tying up this kind of cash for the end savings is right for your budget. Skinflints to the core, we wouldn't fork over the dough until we had product in hand, but that's just us. Where we once frowned on drop-in upgrades, we admit to favoring the Avidyne concept because aircraft previously upgraded to Garmin GNS units should have acceptable wiring or at least wiring that meets modern standards. Do have your shop evaluate this wiring to correct any problems that may be lurking.

During our research, the owner of a nicely retrofitted Saratoga put an interesting spin on his decision to let Avidyne ding his credit card for a $10,000 IFD540 early purchase. He admitted that his GNS530W did everything he needed it to do for his traveling missions, but he was smitten by and ready to buy the Garmin GTN750. That was until his shop presented a staggering proposal for the upgrade, which included rewiring and sizeable amounts of panel work to make it fit. Suddenly the Avidyne drop-in box had great appeal because it promises to advance his panel without the down time and hassles of a major teardown. The potential for selling his GNS530W for $5000 or more sealed the deal.

We think Avidyne's CNS series plug-and-play replacement stack succeeds in doing what Avidyne intends: Modernizing a legacy Garmin stack with limited down time and rework. The rest of the product line includes the DFC-series digital autopilot, which is a system that continues to impress us the more we fly it.

There's also a plug-and-play audio panel and a transponder with ADS-B output. The AMX240 audio panel with stereo intercom is designed for direct replacement of Garmin's GMA 340 audio panel. It has smart features you'd expect, including Bluetooth entertainment and cellphone interface. The AXP340 Mode S transponder with 1090ES ADS-B output can slide in place of the popular Bendix/King KT76A.

We'll look at these products in a future article once they become available.

Sennheiser S1 Passive: High Marks on Comfort

This non-ANR version of Sennheiser's flagship S1 Digital is a good option for passengers in lower-noise cockpits.

by Jeff Van West

Active noise reduction (ANR) headsets are a terrific investment. But not everyone can afford the $400-$1100 to baby the ears of occasional riders. Sennheiser thinks they have a good solution in the passive (non-ANR) version of their S1 Digital headset.

We half agree, finding it an exceedingly comfortable headset, but only up to the challenge of cutting the noise in quieter cockpits.

CODDLING YOUR CRANIUM

The S1 Passive inherited several features from the S1 Digital. The ear pads are thick, with a special "eyeglass zone" of extra pliant foam right where sunglass or eyeglass temples would pass under the earseals. Our experience was good even with thick sunglasses, but there is still some air leakage compared to no glasses at all.

The headset looks quite bulky, but it doesn't feel excessive on the head. It's a relatively light 13.8 ounces, and clamping force is adjustable at one of three settings. However, a lighter clamping force comes at the expense of noise deadening and without ANR, the S1 Passive doesn't have much room to spare. Clamping feels light even at its tightest setting.

There's a separate control box with volume sliders and two features not commonly offered in a passive headset. One is a jack for aux input from a portable music player or cell phone (sorry, no Bluetooth). The other is an easy switch to turn on and off automuting. Passengers usually don't want their music interrupted every time ATC reminds you that you should really be at 10,000 feet. This gives them the option and control.

The aux input requires two AA batteries, and there's an optional auto shutoff that powers it down whenever the intercom is turned off. If the batteries die, the headset works fine, but there's no aux music.

ONLY SO QUIET

Our first test of the S1 Passive was in the relatively noisy cockpit of a Cirrus SR22. We lasted about 20 minutes before we gave up.

The S1 simply wasn't up to the task. Cockpit audio was understandable, but the background noise was high. This became especially evident when we played some music—we had to crank the volume up so loud to just hear the music, the audio started distorting. The S1 Passive won't let you cross 110 dB on audio, but we must have been close. It's not even enough headset for occasional passengers, in our view.

A second test was in the relatively forgiving cockpit of a Cessna 172 SP, whose 2400 RPM engine cruise is low on noise and vibration. Here the S1 Passive was adequate. You'd never confuse it with ANR, but a couple of hours would have passed easily without a migraine.

TV S1 PASSIVE

AVweb

http://snipurl.com/24l0s34

CHECKLIST

- ⊕ Super comfy with auxiliary music/cell input
- ⊖ Passive noise attenuation only adequate for quieter cockpits and cabins

Music in the lower-noise environment was acceptably good without requiring ear-numbing volume. Imagine cranking up the tunes in an entry-level Hyundai on the highway. If you want a true audiophile experience, you'll need ANR.

A GOOD ALTERNATIVE

We think pilots deserve ANR. It's worth the $400 for a basic ANR headset even for the weekend flier. It's worth the $850-$1000 for a really good headset if you spend many hours a month in the air,

We think the $369 S1 Passive would make a good choice for passengers in quieter singles or cabin-class twins where comfort on the head is critical, personal music or phone is a nice plus, and they won't be exposed to the rumble and whine of the skies day in and day out.

CONTACTS

Sennheiser USA
860-434-9190
www.sennheiser-aviation.com

Diamond DA20

For efficiency, speed, view and handling, it's hard to beat. Just don't expect any IFR.

The world of training aircraft has all but reinvented itself since Diamond introduced the DA20 to the North American market nearly 20 years ago. When the Katana appeared, Diamond reasoned that the fleet of ancient Cessna 150s and 152s was growing weary and operators would lust for replacements. What it didn't anticipate was a couple of significant downturns, a glut of overproduction and the rise of the light sport aircraft market. The latter hasn't exactly set towering sales records, but it doesn't take many missed sales to turn a modest program into a struggling one.

Nonetheless, Diamond has still found success with the DA20 as a basic trainer and as an inexpensive, owner-flown fun flyer that's fast enough to fly the occasional cross country, albeit in VFR conditions only.

Flight schools say customers like the DA20 for its sporty looks and handling, reasonable costs and expansive views from the airplane's unique bubble canopy. Although many of those customers might not realize it, there's something else to like, too: The DA20 has one of the best safety records in general aviation, hands down and with no asterisks. But if many buyers put safety at the top of their list of considerations, it appears not to have helped DA20 sales much. Further, the company's follow-on product, the four-place DA40 Star, may have actually siphoned some sales, since both airplanes are commonly used in the trainer role.

> *"The DA20 proved to perform better at our high-elevation airport than other aircraft in our fleet. We could climb and cruise faster and at half the fuel burn."*

NEW, SLICK

When the DA20 showed up as a European import in 1994, there was no mistaking its roots as a sailplane design. It was a T-tailed, all-composite two-seater with high-aspect ratio sailplane-like wings and a huge, rear-hinged bubble canopy that made for unique—and some say awkward—ingress and egress.

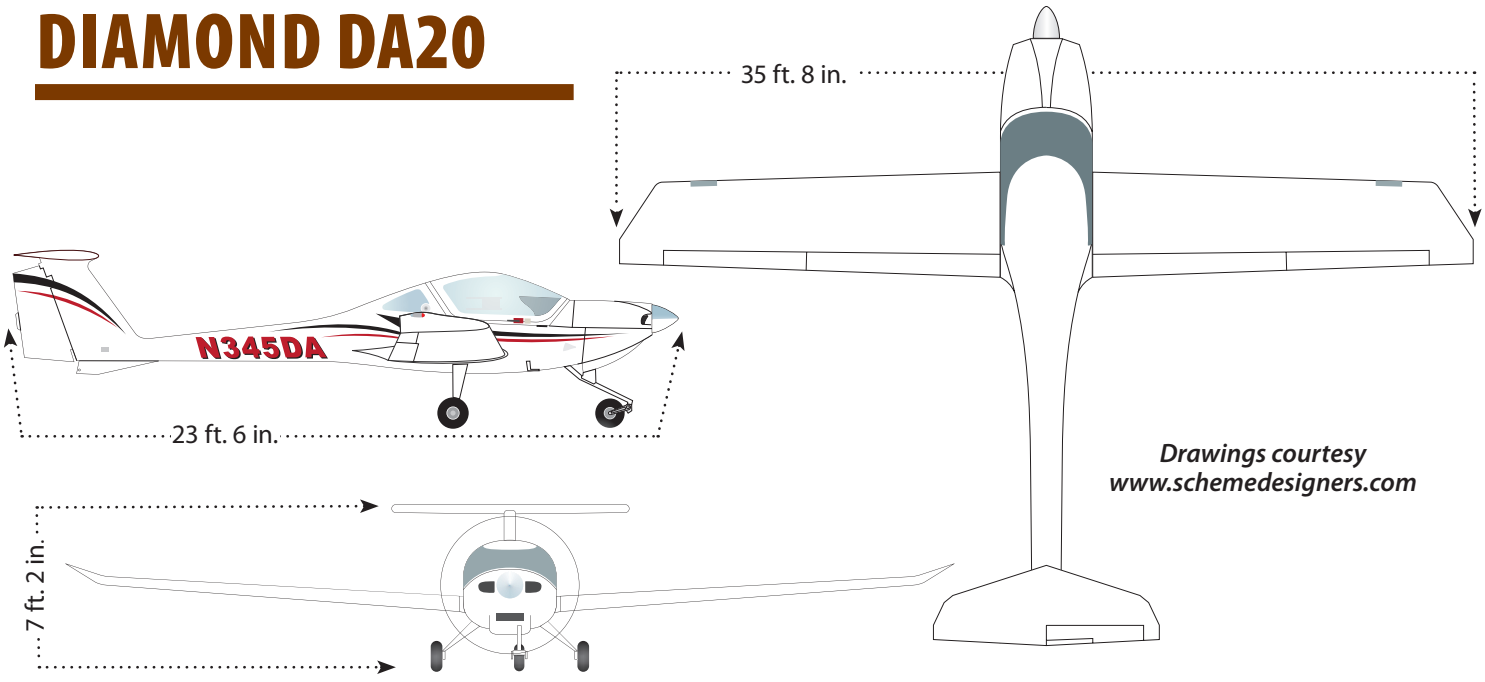
Also unique was the airplane's 81-HP Rotax engine, which many U.S. pilots had never seen, since the engine hadn't made major inroads, even in the experimental market.

The Rotax-powered A1 Katanas at takeoff sounded like a sport motorcycle with a stuck throttle. Chainsaw jokes abounded. The airframe was also much slicker than students used to draggy Cessnas were accustomed to. Carrying too much speed into the flare was a common problem.

Since those early days, the DA20—in its C1 version—has evolved into what some might consider a more serious contender, thanks in part to a Continental IO-240B sporting 125 HP. Today, the DA20 soldiers on, training the next crop of pilots in fleet situations and in the traditional FBO/flight school environment.

Gone is the Rotax, which on hot

DIAMOND DA20

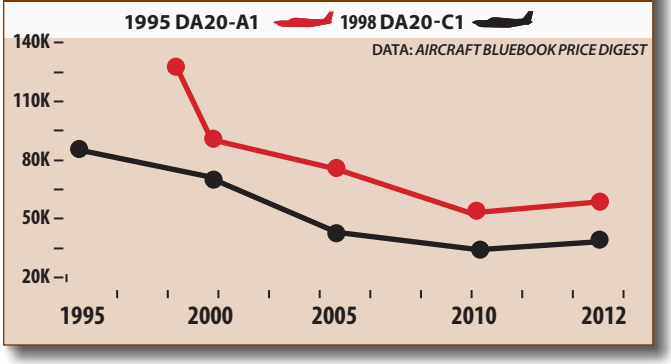


Drawings courtesy www.schemedesigners.com

DIAMOND KATANA MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1995-1998 DIAMOND DA20-A1 KATANA	ROTAX 912F3	1200	$10,000	20	514 LBS	117 KTS	±$34,000
1998 DIAMOND DA20-C1 EVOLUTION	CONT IO-240-B	2000	$21,000	25	488 LBS	132 KTS	±$53,000
2000 DIAMOND DA20-C1 EVOLUTION	CONT IO-240-B	2000	$21,000	25	488 LBS	132 KTS	±$60,000
2001-2004 DIAMOND DA20-C1 ECLIPSE	CONT IO-240-B3B	2000	$25,000	25	554 LBS	140 KTS	±$70,000
2005-2008 DIAMOND DA20-C1 ECLIPSE	CONT IO-240-B3B	2000	$22,000	25	554 LBS	140 KTS	±$90,000
2009 -2011 DIAMOND DA20-C1	CONT IO-240-B3B	2000	$22,000	25	554 LBS	140 KTS	±$145,000

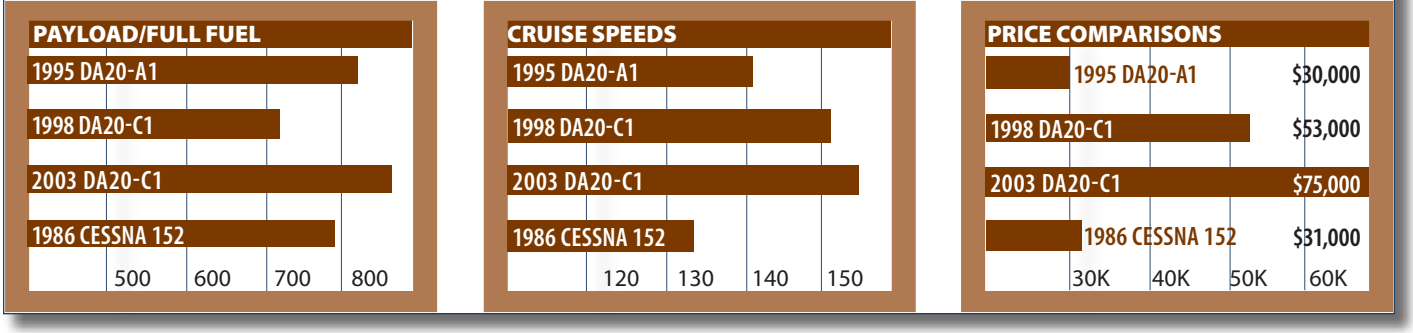
DIAMOND KATANA RESALE VALUE



SELECT RECENT ADs

AD 2012-15-01	ROTAX 912 FUEL HOSE INSPECTION, REPLACEMENT
AD 2002-16-26	REPETITIVELY INSPECT ROTAX 912F AND 914F CRANKCASES FOR CRACKS.
AD 2004-08-10	REPETITIVELY INSPECT ROTAX 912F AND 912S FUEL PUMP ASSEMBLIES.
AD 2005-01-08	REPLACE OIL DIPSTICK ON ROTAX 912F, 912S, AND 914F ENGINES.

SELECT MODEL COMPARISONS



days made climbing to altitude a time-building experience, although you can still find A1 versions powered by it. Most were shipped to Europe, where pilots don't mind the lower power and the aircraft's unique exhaust note is considered unremarkable.

On the used market, its years of service and by now well-known maintenance and pilot requirements make it a worthy contender among the two-seat, tricycle-gear competition for a personal airplane. Given the low fuel burn, it has excellent cruise performance—a good 20 knots faster than competing trainers.

MODEL HISTORY

In the mid-1990s, when the A1 Katana arrived, the general economy was strong and GA was showing signs of a modest recovery in the wake of disastrous sales figures posted in the late 1980s. The watershed General Aviation Revitalization Act and its 18-year statute of repose on product liability lawsuits became the law of the land in 1994, but Cessna wouldn't re-enter the piston-single market until 1997. Simply put, there were few new trainers on the market and Cessna wasn't going to provide any two-place airplanes until the Skycatcher LSA came along more than a decade later.

The DA20's glider roots are evident from any angle. It's more than two feet wider than a Cessna 152, but still four inches less than a 172.

The company that eventually became Diamond Aircraft had been building composite aircraft for quite some time before the DA20. Austria's Hoffman Flugzeughbau was formed in 1981 and began producing the H36 Dimona motorglider, which has evolved into the HK36 and HK36R Super Dimona, better known in North America as the Katana Extreme motorglider. Diamond says it's now the best selling motorglider in Europe and they've sold some in the U.S., too.

With that motorglider as a base, the company's management bought the fledgling airframer and renamed it HOAC-Austria Flugzeugwerk in 1989. Two years later, HOAC was acquired by Diamond's current owners, the Dries family, which is well-established in the automotive business in Europe. Christian Dries, the company's hardcharging CEO and a lifelong pilot, was determined to make a mark in general aviation—and did just that.

The new owners soon began developing the Katana DV20 by shortening the HK36's wings, as well as adding flaps and tricycle landing gear. This design evolved into the DA20 Katana, but it started life at Diamond's factory in Wiener-Neustadt, Austria, as the DV20.

The company set up shop in 1992 in London, Ontario, as Diamond Aircraft Industries. The intent was to develop a North American version of the Katana. The next year, DV20 production went into full swing in Austria. In late 1994 and based on its European paperwork, Diamond received full FAA certification of the DA20-A1, and U.S. deliveries began.

BASIC DESIGN, SAFETY

Even with its slightly bulbous nose, one way to describe the first Katana is "Eurosleek." Diamond has improved and tweaked the basic DA20 over the years, but it seems the Katana was mostly right fresh out of the box.

The composite design includes a pair of fuselage halves joined longitudinally down the airframe's center. The wings are similar in construction, with upper and lower halves joined in a lay-up and vacuum-bagging process. These methods yield accurate, consistent airframe parts. After assembly, the parts are hot-cured in ovens. Although this type of construction had been business as usual in Europe for years, it was new to North America. Eventually, Cirrus, Lancair and even Cessna followed Diamond's lead.

The design is nothing if not robust. The wing spar carries through the fuselage in a box structure designed to accommodate the spring-steel landing gear. Both seats are essentially attached to this structure, which has proven itself over 18 years in the rough-and-tumble world of flight training.

Although the DA20 has suffered its share of accidents and incidents, only three have been fatal in the U.S., according to the NTSB. *Aviation Consumer's* comparative review of aircraft safety which appeared in the January 2012 issue, found that all of Diamond's airplanes from the DA20 to the DA42 twins have exceptionally low overall accident rates and low fatal rates. (See the accident scan for more detailed information.)

The Katana's slender wings span 35 feet, 8 inches (cut down from the 53-foot wings used on the HK36), reinforcing its motorglider roots. Despite their looks, the wings are only 28 inches wider than the Cessna 150/152. The wingtips have a slight winglet-like upturn to help reduce drag.

The DA20 retains the T-tail used on the motorgliders and employs a conventional elevator. The horizontal stab and elevator are just a bit above the average person's eye level, so preflight isn't a hassle, although if

Entrance is from in front of the wing (note the step). Visibility is obviously good up and forward, but it's also good down as you can see in front of the wing's leading edge.

you want a thorough peek at the tail top surfaces, you'll need either a step stool or a short ladder.

Although other T-tail airplanes got bad raps for quirky handling—probably undeserved—the DA20 did not. Its handling is basically without sin and predictable across the entire flight envelope.

LOTS OF GLASS

One of the nicest things about the Katana is also one of the not-so-nice things about the Katana: It has a forward-opening (i.e., rear-hinged) wraparound bubble canopy. While the resulting visibility is unparalleled for a trainer—and most other aircraft, for that matter—a hot summer day can turn the cockpit into a solar cooker. In later models, Diamond addressed this with a shaded top, and that helps keep the temperatures from approaching the interior of a pizza oven on a July afternoon.

Another less-than-appealing aspect of the canopy is that it can generate massive drag if it comes open in flight. In such an event—usually resulting from failure to latch it correctly prior to takeoff or if it becomes unlatched in flight—the canopy pivots back and presents its entire surface to the relative wind. In other words, it becomes a giant, very effective air brake.

This has happened at least once and although the airplane obviously didn't handle normally, the pilot kept it well enough under control to survive an off-airport return to earth.

In later models, beginning with those made after January 1995, Diamond added a warning light to indicate when the canopy isn't latched and improved the latching mechanism for ease of use. We're still not crazy about that aft-hinged canopy, but the accident record suggests it's not the safety hazard we imagined.

The only other issue raised by the canopy is what happens to the occupants if the aircraft comes to rest upside down. In one of the only three fatal accidents in the NTSB's files, a 2004-model Katana being used for primary instruction clipped unmarked power lines during a simulated engine-out landing. The airplane came to rest inverted and caught fire. The accident report doesn't provide details on the occupants' egress, but the CFI apparently was killed outright. The student succumbed to "serious thermal injuries" almost four months later. Worth noting is that as far as we know, this is the only incidence of a Diamond aircraft of any model suffering a post-crash fire.

The baggage area isn't generous. Photo courtesy GLDAS.

POWERPLANTS

North America's original DA20-A1 Katana is powered by a Rotax 912-F3. As such, it became the first "mainstream" Rotax-powered GA aircraft most pilots and mechanics encountered. Rotax was and is a well-known and -respected maker of quality engines for the ultralight, LSA and light homebuilt market. But at the time, a Rotax was unheard of in a certified airplane.

Initially, the Rotax 912 engine had a 1000-hour/10-year TBO. In March 1999, this was extended to 1200 hours/10 years. Again in April 2003, TBO was extended, this time to 1500 hours/12 years. These values are generic, however; review a specific engine's serial number and maintenance/parts history to determine the manufacturer's recommendation. Presently, the *Aircraft Bluebook Digest* shows the DA20-A1's engine to have a 1200-hour TBO; the overhaul's average cost is $10,000 installed.

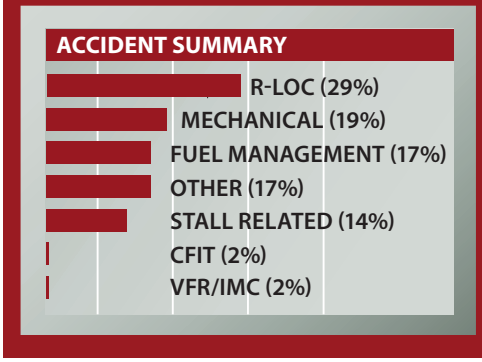
The Rotax engines in the A1 Katanas have delivered generally good service, although Diamond complained about overheating, which Rotax attributed to the installation, not the engine. Over time, complaints about anemic climb made their way back to the factory. For these and perhaps other reasons, Diamond switched to the Continental IO-240B in the 1998 model year, giving it 125 HP and the C1 Evolution designation.

First certificated in 1990, Continental's IO-240-series engines—which basically are two-thirds of the six-cylinder IO-360—generally have a good service record. Beginning in 2004, however, Continental released a handful of service bulletins and service letters designed to address what were termed an "idle stabil-

ACCIDENT SCAN: BOTCHED LANDINGS AND DRY TANKS

When we look at accidents for a specific make and model, we go back a minimum of 10 years and 100 incidents if we can. We couldn't with the Katana, as there were only 42 total in the NTSB database. This makes for a small sample size, but some trends still emerged.

Pilots ending their landing effort somewhere other than a taxiway turnoff topped the hit parade. There were no smoking guns for conditions, although we were astounded by three cases of pilots stalling out of the landing flare. The DA20 has a Vso of 34 knots at gross weight. How slow were these folks going while still airborne? There were a surprisingly high number of stall/spin incidents for a plane with such docile stall characteristics. One was even fatal: a non-recovered spin during flight training. CFI skill (or lack thereof) was implicated by the investigators. Notably absent were any stall accidents due to pilots trying to counter high density altitude with more aft stick.



Some stall outcomes speak volumes about the DA20's crashworthiness. A failed go-around that led to a stall had noted: "Examination of the airplane by an FAA inspector revealed the engine was crushed against the firewall." The pilot was uninjured. Minor injuries resulted after (inadvertent) IMC caused the aircraft to "impact the trees in a 90-degree right bank and at a 45-degree downward pitch." There was the one post-crash fire already noted and three incidents of open canopies—one of which departed the airplane but luckily missed the tail.

Mechanical problems were the usual human foibles, except for one where mistorqued bolts caused partial separation of the horizontal stabilizer. They landed without incident. The "Other" category was a hodge-podge including taxi collisions and wake turbulence.

Fuel management in the DA20 is simple: Have some. The DA20 is efficient, but it needs at least some gas to do more than glide. One determined DA20 pilot departed with the fuel selector in the OFF position. The DA20 tried to warn him: "The low fuel warning light illuminated on takeoff roll with sufficient runway remaining to abort the takeoff. The pilot elected to continue the takeoff." Sigh.

ity problem on the IO-240 engine models."

Transport Canada (TC) put it more bluntly in early 2008: "There have been a number of rough running/unstable engine events and engine shutdowns occurring on Diamond Aircraft (DA) model DA20-C1 powered by the Teledyne Continental Motors (TCM) IO-240-B series engine."

A TC-issued service difficulty advisory noted, "Uncommanded engine shutdowns have occurred during various phases of training flights (stalls, spins and sideslips). Engine idle instability and sputtering at low power have also occurred during the critical approach phase and after landing."

To address the problem, Diamond issued a mandatory service bulletin (MSB) and Transport Canada Civil Aviation issued AD CF-2007-27R1, mandating Diamond's MSB and specifying incorporation of Revision 23 to the DA20-C1 Aircraft Flight Manual.

We couldn't find any U.S. airworthiness directives targeting Continental's IO-240 series engines. For that matter, we couldn't find any significant ADs against the DA20-C1 at all, other than some shotgun ADs related to placards or third-part avionics.

Finally, potential buyers may come across a "Katana 100" variant. This is a DA20-A1 that has been through a factory program costing some $30,000 and consisting of a complete mechanical and cosmetic refit. Part of the bargain was a factory-new 100-HP Rotax 912S and a gross weight increase, to 1654 pounds, providing a 44-pound useful load boost. This variation also is listed in the FAA type certificate and references Diamond Aircraft Drawing No. 20-0100-00-00. The Aircraft Bluebook Digest doesn't list any Katana 100 models.

It does list, beginning in 2001, an additional C1 model called the Eclipse. This wasn't really a different model but simply an upscale equipment package that included leather seats, Garmin avionics and other goodies. It remained in the model line until 2008.

SYSTEMS

In a nod to maintainability and its intended use as a trainer, Diamond made the Katana about as simple as certificated airplanes get. For example, there's no nosewheel steering. Instead, there's a castering nosewheel and steering is accomplished via differential braking, which seems to be the trend in modern fixed-gear aircraft. Early Katanas had high brake-pedal pressure. Meanwhile, a shelf-like structure built into the airframe near the rudder pedals made it difficult for those with larger feet to steer and brake the airplane. This was corrected in later models.

Except for the rudder, which is cable-operated, the flight controls are activated via push rods, which generally provide the pilot with more feedback and responsiveness. The flaps are electric with three positions: retracted, takeoff and landing. The flap switch is panel-mounted and includes a position indicator.

Pitch trim is electric, with no manual provision, yielding one of the few things we don't like about the airplane. A rocker switch on the center console behind the throttle operates an anti-servo tab on the elevator (A1 models), but fine-tuning the trim can be an exercise in excess.

We think the Katana's center stick is one of the airplane's strongest assets. We've always believed students or pilots new to a type adapt more

quickly to a center stick, which we prefer over yokes and the more-recent innovation of side sticks. Even pilots who don't like the Katana for other reasons seem to like the stick.

The Katana's fuel system, while as simple as the rest of the airplane, does pose a potential problem. A single aluminum tank is located behind the seats, forming the baggage compartment's floor. It holds 19.5 usable U.S. gallons in the Rotax-powered A1 version and 24 U.S. gallons usable in the C1. In both models, it's filled from a cap located on the fuselage aft of the pilot's seat.

As a design feature, we don't like the idea of putting fuel lines and hoses in the cockpit space, let alone the entire tank. In our view, the gasoline should be outside the people area, preferably in the wings. Even so, we're aware of only the previously mentioned single accident involving post-crash fires

Since there's only one tank, switching isn't an issue. The single shutoff valve is located on the left side of the center console, near the pilot's feet. The tank has one sump drain located on the left side of the fuselage. In Continental-powered C1 DA20s, an additional fuel system drain is installed on the fuel filter bowl. All DA20s are 12-volt airplanes. The airplane is all-electric, but DA20s usually don't have extensive avionics for the simple reason they were never certified for IFR operation, something many flight schools and owners have complained about.

A1/C1 DIFFERENCES

The Rotax-powered Katana A1 is an easy-to-fly starter trainer, but many flight schools wanted more. The main thing they complained about was poor climb performance. Diamond's first solution to the performance problem was the aforementioned Katana 100 retrofit program.

The second solution involved the C1's Continental IO-240B, with 125 HP. At the same time, Diamond tweaked up the basic airframe, squeezing an impressive 60 pounds out of it. This helped accommodate the heavier Continental engine.

With the lighter airframe, the C1 also got a redesigned horizontal stabilizer, eliminating the anti-servo tab. It also got slotted flaps in place of the A1's hinged flaps and the canopy latch was improved, as were the brake master cylinders. Wing sweep was tweaked by half a degree.

Ergonomically, the instrument panel was moved higher and further forward, creating more knee room. Seatback recline angle was increased to improve comfort. This was a necessity, in our view, because although the fixed seats—the rudder pedal position is adjustable in all models—are comfortable enough for a short training session, they can be excruciating on a long cross-country. Even so, some owners complain that the seats are rock-hard after a flight of more than an hour.

There were some name changes, too. The C1 initially carried the Katana name but in 2000, Diamond renamed the airplane the Eclipse and Evolution, with the former being the gussied-up airplane intended for private owners and the Evolution the training model. The Eclipse has rear windows, pop-out vents, wheel pants, inertial-reel harnesses and Garmin avionics versus Bendix/King products in the Evolution.

PERFORMANCE, HANDLING

Stick-force-to-G is a bit on the light side, which is fine for a trainer, in our view. While we don't think manhandling will ever pull the wings off a Katana, students should find it light enough to be easily mastered. The ailerons are effective—and what adverse yaw there is encourages rudder use. But rudder input requirements remain light-pressure-on-the-pedal, not the thigh-numbing stomp encountered in heavier airplanes.

Stalls are quite gentle and even when we've tried to provoke the airplane into something more sinister, it won't go along. Although plenty of students have ham-handed Katanas and broken plastic as a result, none of these have been due to stalls or stall/spins, as far as we can tell from reviewing the Katana's accident record. The airplane is approved for spins, with the flaps up, something desirable in a trainer.

In addition to its training duties, the Katana is perfect for low-and-slow cruises across the countryside. The Rotax-powered Katanas cruise in the 110-to-115-knot range, which makes them a bit faster than a Cessna 150. Expect fuel burns of 3.5 to

Most DA20s have conventional instruments (below). The Aspen system was offered as an option (left, courtesy Capital City Aviation).

4.5 GPH, which places the A1 Katana firmly on the positively frugal end of the spectrum

The Continental-powered C1 version burns more fuel, but is quite a bit faster. On 7.3 to 8.3 GPH, it'll true out at 125 knots. Also, the C1 comes with a noticeably improved climb rate, easily turning in an 800 FPM initial performance, bleeding off to 500 FPM or so at practice-area altitudes. If you don't think that's a considerable improvement, you haven't spent much time instructing.

As should be expected when considering its role, Katanas have adequate but not generous payloads. Early A1s had empty weights of about 1160 pounds against a gross weight of 1609 pounds. That yields a useful load of about 450 pounds. Throw in full fuel and there's barely enough payload left for two FAA 170-pounders. Obviously, a pair of 200-pounders up front won't cut it.

Allowable baggage weight is 44 pounds, which is quite generous considering that there's very little space behind the seat for anything more than underwear and a toothbrush. The Continental versions have a higher gross weight of 1764 pounds for a typical useful load of 600 pounds. That means full fuel and a pair of heavier pilots up front is a realistic option.

MAINTENANCE, USER GROUPS

Given its simple airframe and overall design, Diamond predicted the DA20 would be a low-maintenance airplane. That's true, but the airplane isn't without foibles. Thankfully, none of them are deal breakers, in our view.

Brake wear and replacement rates can be high, which should not be a surprise, since the airplane is steered with brakes. Early in the A1 version's history, there were a number of reports of cracked spinners. One reporter found all nine of his fleet aircraft with cracked spinners, suggesting pilots pushed on the spinner during ground maneuvering.

A recent review of the FAA's service difficulty reports did not uncover a series of related or linked problems. In the Rotax models, we saw complaints about oil pressure issue and broken exhaust springs, but few beefs about the airframe itself. We didn't find many repeated complaints about the C1, either. There were the usual reports of cracked parts—nosewheel assemblies, rudder pedals, some composite components, but nothing we would consider a characteristic flaw in the airplane. This tends to indicate to us the type has matured and installing revised components—either in the field or at the factory—has resolved many recurring issues.

The DA20 can be thought of as being relatively AD-free. We count eight ADs, on the A1 version and only one on the C1 version. All of these ADs are of relatively minor consequence, not the gotcha variety that might queer a pre-buy inspection.

The Diamond Aviators Association (www.diamondaviator.org), is a relatively new group, having been formed in 2007. A traditional type club, the organization has more of a virtual presence than a physical one, but acquired the apparently defunct Diamond Owners and Pilots Association and merged its membership. The organization says it is independent from but endorsed by the manufacturer and works closely with Diamond to maintain a two-way flow of information.

READER COMMENTS

I own and operate Summit Aviation, a busy flight school in Bozeman, Montana. We currently operate five DA20 aircraft, as well as DA40s,

DA42s, a Cessna 182RG, a Cessna 172S and other aircraft. The flight school began with one Cessna 150 in 2000 and grew to a fleet of Cessnas in 2004.

In 2005, the flight school was growing exponentially, requiring us to consider a fleet of aircraft. My plan for a new Cessna fleet was reconsidered after a friend convinced me to fly a Diamond before moving forward. I flew a DA20 and was immediately sold on its safe flight characteristics, economy, modern design and fun factor.

Fun to fly is very important to me as a flight school owner. After many thousands of hours in training aircraft, it's easy to lose the thrill of flight. Our beautiful mountainous environment combined with the incredible visibility and fun flight characteristics of the DA20 has been a major key to our success. Student and CFI retention is well above average with our school.

The first DA20 was a tough sell to the students initially because it just didn't look like other aircraft. After a couple flights with a few willing students, it wasn't long before the bulk of our fleet was converted to Diamonds. The DA20 proved to perform better at our high elevation airport than other aircraft in our fleet. We could climb and cruise faster and at half the fuel burn.

We found that the DA20 nearly cut our fuel, maintenance and insurance in half from what we were seeing with the 172s.

The ability to offer a brand-new aircraft for the same rental price as the competitors' 30-year-old trainers gave us the leg up needed to succeed. We were also able to get through difficult economic times and high fuel prices, due to the fact our aircraft were so inexpensive to operate.

After more than seven years of operating Diamond aircraft, we have experienced an incredible safety record. The low stall speed, docile flight characteristics and strength of the airframe have contributed to our safety. Every pilot makes mistakes. It helps me sleep at night knowing my students are flying the most statistically safe training aircraft available.

Success as a flight school is due to many factors. Our amazing staff, good business practices, effective advertising, safety programs and a focused effort have helped us succeed. I do believe, however, that if I did not take my friend's advice to fly the DA20, our school would not be the success it is today.

Ben Walton
Summit Aviation, Inc

I fly a 1996 DA20-A1 (with the Rotax 81-HP engine). It is a joy to fly, with excellent visibility, smooth/responsive controls and an excellent safety record. I cruise at between 95 and 122 knots, depending on how much fuel I want to burn en route, and see an average of 3.7 GPH over the past year of operation.

My insurance is about $900 per year and while parts are expensive, Diamond has done an excellent job supporting us, providing a new downloadable (free) illustrated parts catalog. Annuals have been between $650 and $980 a year. My mechanic lets me assist to keep costs down.

Everybody thinks it's an LSA. I think the DA20 is the earliest all-composite aircraft still in production (Windaker Eagle #1 and Beech Starship #2). A1s rarely come up for sale and when they do, they don't last long. Unfortunately, most get boxed up and exported to Europe where avgas is $12 a gallon or more. Of the 341 made, the FAA registration database lists fewer than 50 still flying in the U.S.

I only wish there were more still here so owners could meet up, exchange experiences and help keep them flying. An excellent online resource is Diamond Aviator's Network forums at www.diamondaviators.net.

Alex Gibbs
Via e-mail

I got my pilot license flying a DA20, rented DA20s and when tired of renting, bought a used DA20 from the flight school. In the last five-plus years of ownership, I have enjoyed taking care of my DA20.

Adding wheel pants and an MT prop, I now can get 140 knots TAS, still on 6 GPH. When first insured, the cost was close to $2000. Now it is just over $800 for the year. The annual at the Diamond service center at my airport is very thorough, but very expensive. Maintenance between annuals is light. There have been some repairs along the way, but nothing what I would consider odd.

Name withheld

There are even Garmin G500 DA20s out there—but still VFR-only. Photo courtesy GLDAS.

The Aviation Consumer

Cessna Diesel

(continued from page 7)

and payload advantages. The diesel version will carry the same 87 gallons that the gasoline version does but because it's more economical, it can tanker less fuel for the equivalent range, improving the payload.

Overall, the SR305 installation is about 15 pounds heavier than the gasoline version, but because the prop arc is at the same point, there's no hit on center of gravity. Since it's a four-cylinder, the SMA is shorter than the Lycoming, so there's plenty of room for wrenching between the back of the engine and the firewall, although there's not much back there to service, other than the fuel rack.

CONCLUSION

At $515,000, the Cessna 182 NXT will sell for a 16 percent premium over the $443,000 T182T it will replace. We're not sure how much of the $72,000 price Delta is assigned to the engine, but some must be, confirming Lycoming's claim that diesels are more expensive to produce than proven gasoline engines. That's one reason Lycoming has demurred on developing its own diesel.

The payback is life cycle and operating costs. Two *Aviation Consumer* investigations of STC conversions of the SMA diesel revealed that long-term cost of operation of the SR305 is measurably less than the equivalent gasoline engine, if the diesel makes its TBO numbers without onerous mid-stream maintenance. In our view, there simply aren't enough fleet hours on the SMA engines to prove this beyond question, but what data do exist look promising to us. We're reserving final judgment for now.

If Jet A is the future fuel—and at this juncture, it sure looks as though it will be—Cessna's 182 NXT may be timed perfectly to ignite if not a torrent of sales, a modest trend in a positive direction. Although the economy of diesels is attractive, what the trend is really all about is fuel availability. Jet A can be found almost anywhere—avgas can't.

We've heard it claimed that diesel aircraft sales wouldn't take off until Cessna got into the game and now that it has, we'll soon see if the claim has merit.

Letters

(continued from page 3)

just over five hours each way, nonstop. I flew with Gulf Coast ANR-II headsets.

I've got to say that I am impressed with these headsets. They were reasonably comfortable for that long a time, perhaps a little tight, but they are brand new. Passive noise attenuation is very good and then add the ANR and things are pretty darn quiet.

Things I like: The AA batteries rather than 9-volt; controls are simple and easy—they do the job and ATC said my voice quality was good and finally, the price!

Concerns: I wish the control panel came with a hanging hook or a mounting bracket. I made one up, but it would be a nice feature.

The noise attenuation is better and different from my old TELEX, and the airplane just sounds different. I need to get used to that.

The old headsets had served me for about 3000 hours. I may try replacing the earseals that came with it with the gel earseals that I had on my old TELEX. May or may not be better, but I'll probably try.

All in all, I think GCA has come up with a good product at a great price. I have always thought that ANR headsets were overpriced, so it's nice to see someone make a major cut in the pricing structure. I just hope it's not a matter of "you get what you pay for." Time will tell.

David Lee Ingram
Via e-mail

FEEDBACK WANTED

CESSNA 206

For the December 2012 issue of *Aviation Consumer,* our Used Aircraft Guide will be on the Cessna 206, a popular heavy hauler. We want to know what it's like to own these working airplanes, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your airplane to appear in the magazine, send us any photographs you'd care to share. We accept digital photos e-mailed to the address below. We welcome information on mods, support organizations or any other pertinent comments. Please send correspondence on the 206 by October 1, 2012, to:

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