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The Aviation Consumer

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WHAT'S THE FUTURE FOR DELTAHAWK'S DIESEL?

You know, I've been trying to keep my mind open to Jet-A-burning diesels finding their way in the U.S. GA market, but so far it's been easy to shrug off the notion that the typical engine buyer has a real need for one. Most recently Textron canceled production of its diesel-powered Turbo Skyhawk JT-A, not a year since earning both FAA and EASA certification. The 155-HP Continental CD-155 turbodiesel powerplant is still offered to buyers directly through Continental as an STC'd installation for existing Skyhawks, but whether Textron had buyers or not for the JT-A Skyhawk, it's still a tone-setting setback. Officially, Textron said the decision will help streamline its production process. It's not tough to read between the lines.

Weeks before AirVenture at Oshkosh this past summer, reader Rick Stanton called and asked if I could report on the DeltaHawk DH180A4 engine, since he was seriously noodling the idea of transplanting one in his Skyhawk to replace his timed-out engine. That jolted my memory to follow up with Wisconsin-based DeltaHawk because it originally said its four-cylinder, two-stroke diesel would be certified by AirVenture 2018. That didn't happen, so I made tracks to the DeltaHawk display at the show where the company was showing an enhanced 180-HP version of the engine that it has been testing on a Velocity V-Twin experimental airplane.

DeltaHawk CEO Christopher Ruud admitted that the company put the brakes on the project (even backing away from the STC process), but a shot of funding boosted the company's workforce to 35 employees (from three), plus it allowed some developmental changes to the DH180 series. The direct-drive engine (shown in the photo above) has a dry weight of around 340 pounds including the turbocharger, the exhaust and accessories. I eyeballed the engines as installed on the Velocity and they're a lot smaller than the Lycoming engines that came off. That means smaller, lighter cowlings with less drag. There's no Fadec on the DeltaHawk diesel, but instead mechanical fuel injection. Based on its testing to date, DeltaHawk says the 180-HP engine (which can be configured in 160- and 200-HP versions) burns 7.5 GPH at 75 percent power. Recent improvements include more glow plugs, better liquid cooling and a different bolt-on head structure. DeltaHawk isn't really talking about the final selling price of the engine, but it will certainly be more than a typical overhauled Lycoming IO-360, as just one example. The initial STC will be for Cessna Skyhawks.

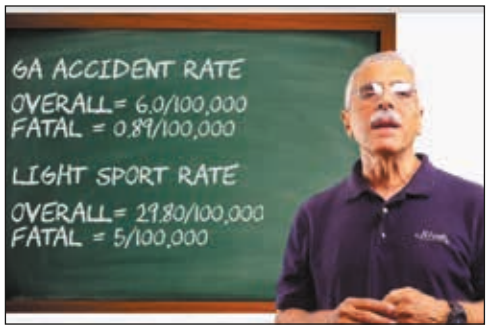
Ruud, who has lengthy experience in the turbine engine world, has a lofty goal of certifying this engine without a TBO. He told me that DeltaHawk has demonstrable data that proves it can monitor the engine for on-condition overhauls. Since 2000 hours has become the general magic number for aircraft piston engine TBO, Ruud believes that's easily obtainable given the robust nature of diesel engine tech, citing the widespread use of diesels in the trucking industry. He's right in that there are fewer moving parts and less complexity in running a compression ignition system rather than with spark ignition, plus there are no electronics needed to run the engine. The first thought that came to mind was a drone application for the DeltaHawk engine and my instincts were right.

One of DeltaHawk's business models is indeed U.S. military drone applications and the fact that these engines can be built in Wisconsin is an advantage under the current government, in my view. Yes, President Trump likes stuff that's built in the U.S. and Ruud knows it.

But Ruud admitted something most of us already knew: Demand for diesel airplane engines is much stronger outside of the U.S. and over 60 percent of the inquiries for the DeltaHawk engine are from overseas buyers. Does that answer the question in the above headline? You draw your own conclusions, and in the interim I'll keep tabs on the DeltaHawk engine's certification status and we'll report on the progress. —*Larry Anglisano*

MORE ON LSA SAFETY

I enjoyed your LSA accident review article in the August 2018 *Aviation Consumer*. I was a Light Sport pilot examiner (DPE) for many years until I retired at the end of January this year, so I have more than a passing interest in the category.



Conspicuous by its absence is any mention of the Evektor Sportstar. We had (past tense) several of them here in southern Indiana, and I administered a lot of checkrides in the Sportstar. I believe that the Sportstar is a major player in the LSA community, with a couple hundred of them flying in the U.S. At one point I think they were the third most numerous LSA, behind Flight Design and Legend. That would put them in the middle of the pack of the ones you considered. And I know the Sportstar had its share of accidents. Why did you omit the Evektor from your accident statistics?

Larry Boothe
via email

We initially set out to include all the LSAs, but because of the sheer number of manufacturers, had to pare it down to something manageable, both for editorial space and time resources. That project required close to two weeks of work so we contained it by picking the top 10 aircraft in the FAA registry. The FAA registry shows 92 Evektors in the U.S. That made it number 11 on the list.

The registry lags so there are more than that, but that's true of all the airplanes. In retrospect, I might reconsider because the Evektor line has a pretty bad accident record. Just a quick look reveals 36 accidents, three of them fatal. That would give it the highest overall rate, and toward the top in fatal rate, depending on the time period considered. In a previous article, we did look at the Evektor and the results were about the same.

BACKUP EFIS SNAG

I'm trying to keep the panel of my 40-year-old Cessna 172 up to date, but in smaller bites and not having to drop $20,000 all at once. When looking at the options for digital attitude indicators, the devil is in the details.

I'm a belt and suspenders guy and not ready to get rid of my vacuum attitude indicator yet. I have two—the vacuum and the electric AI. I also have an Avidyne IFD540 that needs a baro input to sequence track-to-altitude legs for missed approach guidance. To get the baro output I could buy an air data computer and appropriate altimeter, priced over $6000. The more logical option seems to be an electronic attitude indicator, but Garmin's G5, Dynon's D10A or Sandia's SAI340 Quattro don't have the required digital output. But the L3 ESI-500 does.

Unfortunately, it's only approved as a backup, which means I'd have to keep the old vacuum gyro in the primary position—ridiculous given the ESI-500's capabilities.

When you looked at the backup EFIS market in 2015 you mentioned the FAA's new guidance for installing electronic attitude indicators as primary without providing a specific reference. Recently, L3 informed me its instrument is only for backup. Where is the paper trail to convince a shop to install one as primary?

Vince Fischer
via email

The shop is the one to create that paper trail, referencing the FAA's policy statement PS-ACE-23-08, which we specifically wrote about in that December 2015 Aviation Consumer EFIS article. In summary, the policy statement says that it's acceptable to replace single-function vacuum-driven attitude instruments with electronically driven attitude indicators as long as they have an independent standby battery capable of meeting the intent of multiple EFIS installation advisory circulars. Follow the guidance and the FAA considers the installation a minor alteration, as long as the instrument has a TSO.

The ESI-500 has an STC, which specifically defines the device as a standby backup instrument. A shop can lobby an FAA field approval as an alternate means of certification and you'll pay for the additional effort, but with no guarantee that it will be approved.

In our view, it's worth getting a proposal comparing that option with an Aspen Evolution EFIS, which has the air data outputs for the Avidyne.

WHEN SIZE MATTERS

As a longtime subscriber to *Aviation Consumer*, I would like to bring to your attention the common practice of misrepresenting the actual diameter sizes of the two common round mounting holes in standard aircraft instrument panels. The 2-inch instrument panel hole referenced in the September 2018 low-cost EFIS article in *Aviation Consumer* is actually 2.25 inches, and the 3-inch hole is actually 3.125 inches.

The problem with mistaking the actual size of the instrument hole is that some might assume the instrument won't fit properly in the panel.

Bill Hemme
Spencer, Indiana

That's precisely correct.

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AIRCRAFT FLIGHT TRIAL

Mooney Acclaim Ultra: Tops in Raw Speed

Mooney found a few more knots in the Ultra and gussied up the long body with a second door, NXi avionics and a posh interior.

by Paul Bertorell

A nerdy parlor game for aviation obsessives is to ponder how much further Mooney can stretch its decades old tube-and-sheet design into yet another new product. In this report, we're looking at the M20V Acclaim Ultra, and that leaves four more alpha designators for something new.

Although it's really an incremental upgrade to the long-body M20 series, the Acclaim Ultra was a major certification project for Mooney at a time when we're not seeing many of those—from anyone. The results inarguably make the Acclaim Ultra the fastest four-place certified single-engine piston airplane and not just by a little. The Acclaim goes head to head with both its normally aspirated sibling, the Ovation Ultra (see February 2018 *Aviation Consumer*) and both Cirrus models, the SR22 and SR22T which, together, constitute the current market leaders. That puts the Acclaim into a niche within a niche—a slice of buyers who want speed, but care less about cabin size or payload. Pricewise, at $789,000 base, the Acclaim invoices below the typical Cirrus models.

LONG BODIES

The M20V traces its DNA to Mooney's first all-metal models that then and now combined a hell-for-strong welded-steel cabin cage with a traditional riveted monocoque after section. The Ultra twins owe their stretched cabins to one of Mooney's ill-starred dead ends: the Porsche-powered PFM. Although the engine was disastrous, the airframe endured and became what's known as the long-body airframe.

That design matured into the Lycoming-powered Bravo and, in 1994, the more successful M20R Ovation. A combination of market timing, a good economy and credible performance made the Ovation a hit for Mooney. But the company's 1997 attempt to follow that with a revival of the turbocharged short-body M20K, the Encore, was another anemic seller.

In 2006, Mooney addressed that by essentially turbocharging the Ovation with Continental's 280-HP TSIO-550-G. This became the Acclaim and a couple of years later, with drag cleanups, it morphed into the Type S, which Mooney rightfully claimed was the fastest piston single.

The 2008 downturn ended Mooney production and, except for parts support, the company once again went into stasis until the China-based Meijing Group bought it in 2013. An infusion of cash funded another soon-to-be stalled project, the M10 trainer, a major redo of the long body and modernization of the factory.

Cosmetically, the airframe doesn't look much different, save for the new door on the pilot's side. But this proved a major certification project for Mooney, requiring two years to massively rejigger the welded cage

Both the Acclaim (foreground, top photo) and Ovation share the redesigned cage and cabin that now has a pilot-side door, lower photo.

CHECKLIST

- ✚ You're not going to go faster in any other certified piston airplane.
- ✚ Pilot-side door, G1000 NXi and improved interior are big plusses...
- ~ ...but the wide, rotund and tall among us will still find the cabin tight.

to carry flight loads around the new door opening. And thanks to the composite experience gained through the M10 project, the forward cabin is now skinned with a fiberglass composite shell that may eventually evolve to carbon fiber.

The shell, which is clipped to the steel cage, has implications for assembly efficiency because it allows technicians unrestricted access to install wiring, hardware and fixtures before the cabin is enclosed. That squeezes hours out of the build time and chips away at production costs.

For pilots, the new cage and shell offer stiffer composite doors whose openings are four inches wider and an inch-and-half taller. The doors also get new latching mechanisms and tasty brushed aluminum handles.

THE SAME BUT DIFFERENT

The airplane sports dozens of less obvious improvements, including a carbon fiber cowl, gear doors and wingtips and drag cleanups, including a gap seal for the flaps. Mooney has always been obsessive about flush riveting and still is. Lee Drumheller, who sells Mooneys for Fort Lauderdale's Premier Aircraft Sales, likes to point out the flush-riveted aerodynamic housing around the fuel vents. "No one else does that," he says.

Mooney's production chief, Rob Dutton, says the company has nicked hundreds of hours out of production time, but the airplanes are still a complex build. The wing is a giant, single-piece assembly with a riveted spar that would do a suspension bridge proud. The M20s still have wet-wing fuel tanks, but now they're sealed with improved compounds intended to last longer before resealing.

The control circuitry is the same steel tubes Mooney has always used, yielding a precise if occasionally stiff control feel. The gear system is similarly tube driven via an electric motor in the cabin center section. Along with the Beechcraft design, this system has proved to be the most reliable in general aviation and is tolerant of less-than-perfect maintenance. Same for the flaps. They're electrically activated with a ready-to-the-hand flap-shaped toggle on the panel with presets for takeoff and landing.

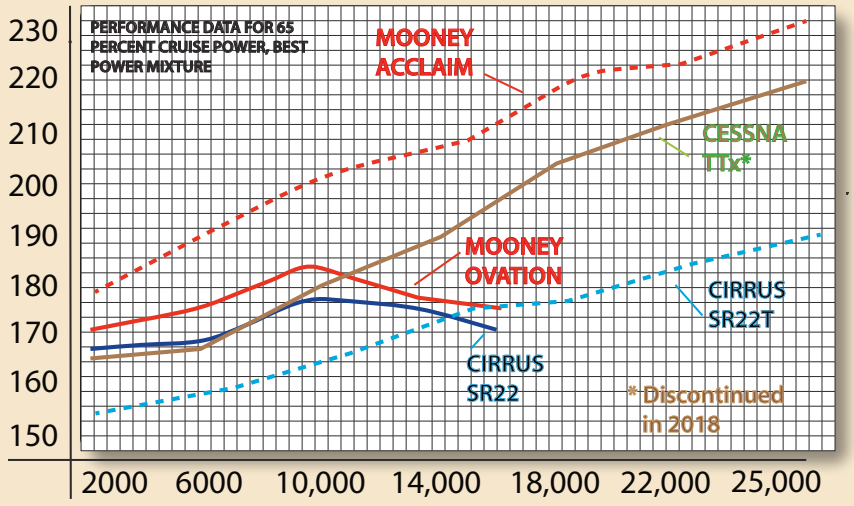
And while we're on the panel, both Ultras have a new version of it that includes reorganized switchology with rockers rather than toggles. Critical items—master, alternator field and emergency bus—have red rockers on the far left, while everything else is black. Exterior lights are on the overhead; not my favorite. The panel is well organized, but because of its limited size, some switches are obscured by the yoke.

Both Ultra models offer the Garmin G1000 NXi, top. Displays are brighter and refresh faster. The interior reeks of expensive leather, including tasty yoke coverings. Carbon fiber cowl, bottom, is light enough to install unassisted.

As does about every other new airplane, the Acclaim Ultra has Garmin's G1000 NXi. (See February 2017 *Aviation Consumer* for a full review.) This system has faster processing for a quicker startup and almost instant graphics refreshing. The displays are brighter and crisper and Garmin seems to have simplified the operating logic.

The NXi is fully coupled to the GFC700 autopilot, with a vertical control panel situated between the two display screens. The autopilot has envelope protection for overbanking and overspeed, but it doesn't have the blue bail-me-out righting button pioneered in the Cirrus Perspective version of the G1000. The GFC700 has a reputation as the best new autopilot in GA and it's deserved. It allows flexible aircraft control and the ride is silky smooth.

The Ultras are so loaded up that there aren't many options, avionics wise or otherwise. For ADS-B In and Out, the airplane has the GTX345R



ACCLAIM: FASTER AT ALL ALTITUDES

The Acclaim's performance profile, top chart, is nothing if not flexible. It's faster at all altitudes than anything in the four-seat high-performance class, although it gives up some climb performance to the Ovation at lower altitudes.

With tanks full, it's a two-place airplane with a moderate baggage load. Three people will be a push, leaving payload enough for about 720 miles of still-air flying with a 45-minute reserve, as shown in the chart below. Those numbers assume best economy cruise below the oxygen altitudes.

For owners who don't mind using a cannula or mask, the Acclaim's performance reward is 230 knots-plus in the flight levels, where it leaves the competition far behind.

ACCLAIM USEFUL LOAD AND RANGE	
USEFUL LOAD	940 LBS
WITH AC OR TKS	875-900 LBS
PAYLOAD TANKS FULL	406 LBS
RANGE	
FULL TANKS RANGE	1025 NM
THREE-SEATS RANGE	720 NM

along with the GDL69A for XM data. For $16,720, a buyer can add the GTS800 active traffic system, but Drumheller says few buyers do because ADS-B traffic performs so well.

Also on the option menu is FIKI-approved TKS and air conditioning. But because of the weight hit, that's an either/or, not both. The AC is a $28,900 option with a 66-pound penalty. TKS weighs 95 pounds fully charged and adds $64,990 to the invoice. Surprisingly, Drumheller says neither option is particularly popular, especially in his southeastern territory where icing is less of a concern. And with the second door, holding it open for a cooling breeze during taxi may be a suitable alternative to AC. For an additional $10,000, Mooney offers what it calls Fill and Fly. It covers all the maintenance and consumables except fuel for three years or 300 hours, whichever comes first. That includes annuals and adding up the numbers, it strikes me as a good value. Even a new airplane can easily have a $3000 annual.

NO HEAVY HAULER

Mooney's turbocharged models have never been payload workhorses and neither is the Acclaim Ultra. With AC, the demonstrator I flew had an empty weight of 2511 pounds for a useful load of just 857 pounds on a max weight of 3380 pounds. Fill it with 89 gallons and the airplane has a payload of 323 pounds. Without the AC, it would be 389 pounds. That makes it a two-people-with-baggage airplane. Down fueled to, say, 50 gallons, you can put three people into the airplane, with moderate baggage. That's three hours at middling power settings or four at economy speeds.

Obviously, this is a significant compromise against the Cirrus SR22T, which claims best-case useful loads of 1248 pounds. In the real world, it's less than that. But with three hours of fuel, plus a reserve, the Cirrus can carry four people. The tradeoff is the Acclaim gets there a little faster and/or goes a little farther because of its higher cruise speed.

Oxygen—a 77 cu. ft. system from Precise Flight—is standard equipment on the Acclaim, while it's an option in the Ovation. That assumes owners will want to climb into the high teens or even up to the airplane's maximum certificated altitude of 25,000 feet. Some owners clearly do that, but on our trial flight, Drumheller pointed out that the Acclaim speeds along handily at 12,000 feet, sans sticking a plastic tube up your nose. There's something to be said for that.

The M20V gets that performance the same way the Ovation does, with Continental's IO-550 engine, the de facto standard these days for high-performance aircraft. The Acclaim's TSIO-550-G has two intercooled Kelly Aerospace turbochargers. The specs claim the engine is turbonormalized, but I'd call it ground-boosted, delivering up to 34 inches of boost.

While the Ovation gets 310 HP from the IO-550, the Acclaim's version is derated to 280 HP. If that sounds like the Ovation will outclimb the Acclaim, it will at sea level on a standard day, by a couple of hundred feet a minute. That advantage fades when the density altitude gets to about 7000 feet. The Acclaim maintains its rate; the Ovation doesn't.

FLIGHT IMPRESSIONS

Lee Drumheller says the Ultra's pilot-side door is a potent sales tool and it's easy to see why. It eases ingress and when both doors are open, the cabin is airier and more comfortable, even if a little contortion is still necessary. The back seats are tight until the front seats are slid forward to the normal

flying position. The new seats—built and upholstered in-house—are done up in leather similar to luxury sedans.

Flight handling of Mooneys hasn't changed much since the Bravo days. Compared to a 201, the long bodies are stiffer in pitch due to the engine hanging so far forward. It takes a tug to pop the airplane loose on takeoff and a touch to keep the stall lady from squawking.

For landings, Drumheller reminded me that the way to land a long body is to neutralize the heavy forward pitch moment by running the electric trim full up during the flare. That produces near-perfect touchdowns every time.

The Acclaim climbs briskly at about 1100 to 1200 FPM to as high you want, with good visibility over the nose at 120 knots cruise climb speed. Although Mooney lowered the glareshield in the new models, the view forward isn't as expansive as a Cirrus or a Diamond. That's a consequence of the small frontal area that gives the airplane its speed.

And the speed is impressive. We climbed to 13,500 for a speed check—about 10 minutes—and noted 206 KTAS, leaned 50 rich of peak at 21.9 GPH. That's a little slower than the POH numbers, but also not a practical fuel burn. On the economy side, at 50 degrees lean, the Acclaim trued at 172 knots on 11.1 gallons. That equates to seven hours of endurance and nearly 1200 miles of still-air range, with reserve.

If you want speed *and* economy, you'll have to take the Acclaim high. At 25,000, it can do 216 knots on 16 GPH, for a still-air range of 1000 miles-plus. But only with two people and light bags. That's probably the buyer Mooney will have to find for this airplane and/or people who just don't like the Cirrus for whatever reasons. The Mooney offers a $100,000 lower price tag for comparably equipped airframes, but for someone who can afford to write a check for these aircraft, I'm not sure if price sensitivity is an issue. Drumheller says it is not between the Ovation and the Acclaim. Buyers who want to go fast just want to go fast and they'll pay for the hardware to do that.

YouTube **See a video of the Acclaim at http://tinyurl.com/j95ht2a.**

MORE INVESTMENT IN KERRVILLE

Given Mooney's string of bankruptcies, fire sales and musical CEOs, a buyer about to write a check for most of a megabuck for a new airplane might logically ask: Are these guys gonna survive?

The answer may reside in an unlikely place: A fenced-in cage at the back of Mooney's main assembly hangar in Kerrville. From within comes the parts support for a fleet of more than 11,000 Mooneys, back to nearly day one.

Although that parts flow has been better in some years than others, support for the fleet has never dried up entirely and Mooney sales manager Jeff Magnus says the Meijing Group wants to keep it that way. Meijing, a China-based real estate developer, along with other investors, bought Mooney in 2013, renaming the company Mooney International.

The company admits to a capital infusion of at least $150 million, to include development of the now-shelved M10 project, factory improvements and the certification of the M20U and V models. It also funded a Chino, California-based design and development shop, which has since been shut down.

Magnus says the company is in the aviation business for the long haul and sees a profitable future when the long-awaited Chinese general aviation market potentiates. This remains an aspirational goal. A couple of M20s prepped for shipment to China were turned back into the U.S. market simply because China couldn't readily process the certifications.

For the time being, the company is sustained by multiple revenue streams from spare parts and support, outside contract manufacturing for other aerospace companies and its own aircraft manufacturing.

In the current flat market, production at Mooney is about one airplane a month, but it hopes to reach as many as 30 a year within a year or two. "We think 50 a year is doable. The market can absorb that and that's a sweet spot for us," Magnus says. The longer view sees demand in China, if not for the M20 then for something else.

One something else was supposed to be the clean-sheet composite M10, a program that envisioned a fixed-gear trainer and a retractable cruiser. Mooney has indefinitely shelved that project in the face of weak potential demand.

The positive offshoot was that composite capability was moved to Kerrville and leveraged into building the composite cabin shell for the M20U and V. And Magnus says work done at Chino may yet find applications. "From the Meijing Group's point of view, it just didn't make sense to introduce three new airplanes. In a couple of years, you may see something similar to the M10 coming back," Magnus said.

Meanwhile, he says the factory will begin supporting upgrades of older models with glass panels—Dynon is under consideration—and modern interiors provided as kits. Such packages, he says, would be provided to Mooney service centers for field installation.

BendixKing AeroVue: Cursor-Driven EFIS

The AeroVue EFIS retrofit is an automation injection for aging King Airs. More STC approvals could give it a competitive edge in the turboprop refurb market.

by Larry Anglisano

It took a few years for BendixKing to earn an STC for its AeroVue retrofit glass cockpit for B200 King Airs, but that's no surprise. Without question, the STC work was a major effort. The AeroVue is a complex system with a three-axis autopilot/flight control system and automation that's well-suited for business jets—which is where the system was born.

But the challenges aren't over. The King Air avionics retrofit market is dominated by Garmin, which has been populating the G1000 system in the older King Air fleet, in impressive numbers, for a number of years.

For a taste of the AeroVue's feature set and overall airframe interface, I flew with the system in Honeywell's STC airplane, a mid-1980s vintage King Air B200. Here's a flight report.

BIG SCREENS, NON TOUCH

The AeroVue IFD (integrated flight deck) looks and functions a lot like the four-screen Honeywell Apex integrated avionics suite used on the Pilatus PC-12NG turboprop. Both systems have architecture that trickles down from Honeywell's Primus Epic avionics.

The suite for the King Air has three high-resolution 12-inch color LCD screens. There's pilot and co-pilot primary flight displays and a multifunction display. The displays are instant-on and the whole system comes up ready in roughly 20 seconds. The screens have multilayer anti-reflective coating that permits a pretty wide viewing angle—as much as 80 degrees. They simply have to be high performers for big cockpits and the are. There's a dedicated autopilot controller directly above the MFD, plus two PFD controllers.

While the AeroVue has its own CAS (crew alerting system) for visual and aural notifications, the King Air's various system warning annunciators are left alone (as is the environmental system) to minimize installation complexity. In the B200 I flew, the external annunciators were nicely located in an area of the panel that's forward of the power levers, plus there's an annunciator panel in the center of the glareshield. Engine and fuel system data is displayed on both PFDs.

Like the Apex in the Pilatus, the AeroVue isn't touchscreen. Instead, it uses a combination of bezel keys, knobs and joystick commands for entering data and navigating the menus. But the best way to move around the system is with the trackball cursor control device (CCD). In the King Air it's mounted in the center pedestal below the multifunction controller, which has an alphanumeric keypad and various buttons and knobs used for FMS data entry and for controlling the weather radar, terrain system and a variety of other systems.

BendixKing told me it avoided a touchscreen interface on the AeroVue because the trackball and CCD is proven on the Apex/Epic, resistant to the challenges of inputting data in turbulence. It works. But if you're used to flying with touch avionics, you'll initially reach up to finger the AeroVue screens. You'll get nothing other than fingerprints on the glass. Garmin's G1000 NXi for the King Air (or for anything) doesn't have a touch interface, either.

The onscreen cursor is initially displayed with a circle around it when it's moved among displays or when reactivated on the map after having timed out. The circle begins to fade away immediately and completely fades away after five seconds until only the cursor

CHECKLIST

- ⊕ A well-executed, weight-saving integrated flight deck that excels in autopilot automation.
- ⊕ Trackball and cursor inputs make data entry seamless.
- ~ But it's a touch world and some buyers might want a hybrid touchscreen interface.

We give the AeroVue high marks for ergonomics. The backup EFIS is logically positioned to the left of the pilot's PFD, the PFD controller to the right and the audio panel at the top. That's the MFD in the center image with INAV map, flight management and CAS windows. The photo at the bottom is the pedestal-mounted multifunction controller with trackball and cursor control device.

remains. The logic behind the circle is so the operator can quickly identify it on a screen. If you've worked with multiple computer screens, you understand. It vanishes from the screen after 60 seconds of inactivity and it's displayed the same using the CCD or the system's joystick.

The bezel of each identical display has four groups of six buttons (12 per side) and their functions change depending on what is being displayed. White lines are located adjacent to each softkey that match each bezel button with the corresponding softkey. I flew with the system on a bright summer day and found the LCD screens easy to read when sunsplashed.

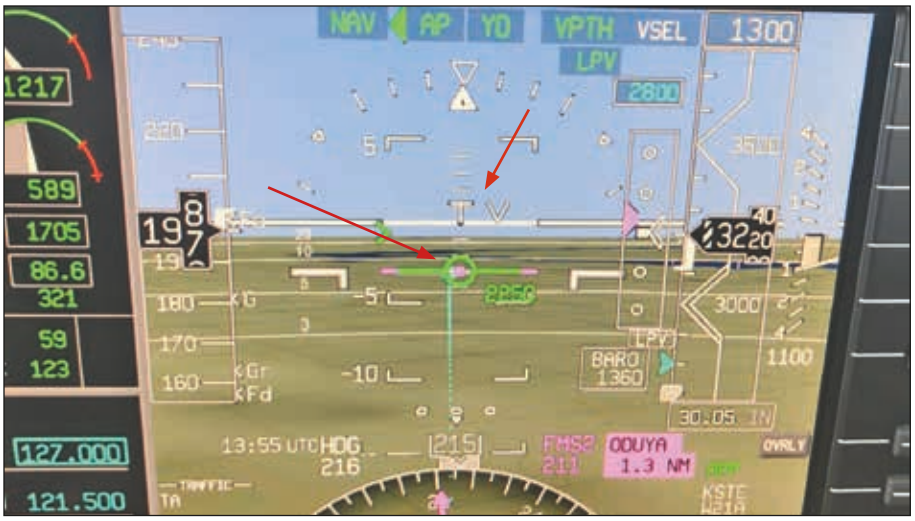
Each PFD controller is split into two sections. The upper portion has a dual concentric knob for setting the baro, setting up bearing pointers and setting the nav/GPS course and map display range, to name a few, while the bottom part of the controller has a volume knob for the VHF radios. There's also a transponder Ident button, a tuning knob and a nav source select key for cycling through the navigation sources displayed on each PFD.

In addition to dual WAAS GPS systems, a core component of the AeroVue is the KSG-7200 dual-channel ADAHRS. For old King Airs, this is a major step up from their ancient remote gyros and air data computers. The AeroVue saves a lot of weight—as much as 150 pounds—thanks to more solid-state magnetometers, MEMS-based (micro-electro-mechanical sensor) accelerometers and solid-state air data transducers.

In addition to supplying flight instrumentation to the PFDs, the ADAHRS is used by other subsystems in the AeroVue suite, including the ADS-B transponders (there's no ADS-B In), the autopilot, the aircraft's cabin pressurization system, plus the terrain and traffic systems. It's really a deep interface with plenty of redundancy, as you'd expect for a King Air.

The primary ADAHRS channel supplies pitot and static data to the left PFD while the secondary channel supplies the data to the right one. If one ADAHRS channel fails, simply press the ADHRS button for the failed PFD and the system connects the working channel. Each display is backed up with its own SAM standalone EFIS, made by Mid-Continent Instruments and Avionics.

As for VHF radios, it's



The screen grab at the top captured on an autopilot-coupled approach shows the flight path symbol (FPS) with the SmartView in path-based mode. The red arrows point to it, and the V and T labels, showing where the aircraft is going in relation to the heading and track. The photo in the middle shows a loaded Jeppesen chart, plus active approach segment data on the MFD. At the bottom, notice the engine data and radio status logically arranged on the PFD.

out with the old two-piece (control head and remote transceiver) and in with the KTR-2280 multi-mode, software-driven radio system called the MMDR. It handles all non-GPS-based functions, including transponder, comm, nav radios and a DME. These are all operated using the PFD controller, the cursor control device and the Bluetooth audio panels made by PS Engineering.

SMARTVIEW SYN VIS

BendixKing's version of 3D synthetic vision is called SmartView and it has a deep feature set. It starts with a traditional blue over brown flight display and then builds upon it by overlaying the EGPWS (enhanced ground proximity warning system) database for a synthetic terrain and obstacle background on each PFD. The system also adds HUD-like symbology to the display, a feature used on the other Honeywell suites in jets. There's a lot of data displayed on the PFD, and where other manufacturers' syn vis displays can be cluttered, I think the Honeywell engineers did a good job with the AeroVue's presentation. Make no mistake, there's a lot of data thrown at you, but it's configurable and some data is shared on the MFD.

For example, the field of view displayed on the PFD is also depicted on what is called the INAV (interactive navigation) display over on the MFD's map page. On the PFD when syn vis is turned on (and in addition to familiar flight director command bars), there's a flight path symbol, track and heading reference symbols and an acceleration chevron that aids in energy management. In addition to (and in unison with) the flight director command bars, there's the option of displaying path-based and pitch-based symbology.

In the path-based mode, the primary reference for flying is the flight path symbol, or FPS. In this mode the flight director command bars are displayed with reference to the FPS—which is the primary guidance symbol on the PFD and is highlighted in green. It's the opposite in the pitch-based mode, where either the flying wedge (a single-cue aircraft symbol) or gull wings (crosspointer symbol) are the primary and dominant reference cues and displayed in green. In the pitch-based mode, the FPS is still displayed, but it's de-emphasized with a smaller size and gray color.

In a flying world where many have transitioned to synthetic vision cues, I think most will fly the AeroVue in the

path-based mode using the flight path symbol as the primary guidance.

The FPS is the circular symbol with horizontal bars that indicates the current flight path angle. It's pretty intuitive, moving up on the pitch tape for increasing flight path angles (relative to the horizon) and down for decreasing flight path angles. And, the FPS can be displayed in conjunction with the command bars. If the command bars are turned off, the FPS has a green dot in its center and when the bars are turned on, the dot is removed so the symbol can better align with the flight director.

The FPS also includes an acceleration chevron, displayed as a green greater-than symbol to the left of the FPS. Its position with respect to the flight path symbol indicates the acceleration or deceleration of the aircraft, corresponding with the current indicated airspeed. In the real world, this is useful for setting the power for hand-flown climbs, descents and whenever you want to maintain a constant airspeed, in which case keep the chevron aligned with the FPS.

Descending out of 9000 feet for 5000 feet, the acceleration chevron positioned itself above the flight path marker, indicating an excess in energy and resulting speed increase. Pulling the power levers to idle put the chevron below the marker, offering at-a-glance cues of the aircraft's decreasing energy state. Since the SmartView system is based on the aircraft track, the PFD displays an onscreen "V," which depicts the current heading, and a "T" for the current track.

When the autopilot is flying (which in the King Air is probably the majority of the time when flying instrument approaches), the AeroVue's automation is impressive and has some built-in failsafe functionality for avoiding altitude busts. Honeywell calls it VNAV technology. On my demo we flew the RNAV approach to Stevens Point Airport in Wisconsin, and with the decision altitude set in the autopilot preselector window and the approach loaded, the system automatically stepped the aircraft down to the published altitudes in the approach procedure. For example, input 1300 feet in the preselector and the autopilot will level the aircraft at 3000 feet until reaching the next point in the stepdown, where it descends.

King Airs are often flown single pilot and I think the AeroVue makes that chore easier, but like any integrated avionics suite, you absolutely must have a firm grasp on system architecture. No, Garmin logic won't work—not close. BendixKing offers one-on-one, real-world AeroView transition training, plus use-case training videos.

YouTube See a video of the AeroVue at http://tinyurl.com/j95ht2a

MOVING FORWARD

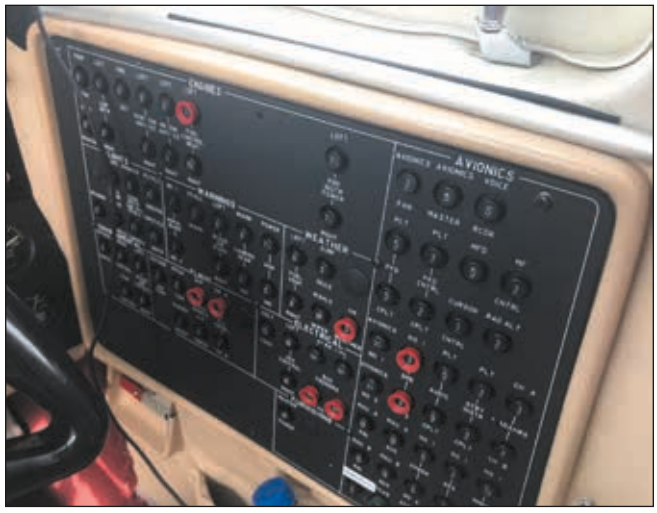
BendixKing launches the AeroVue for the King Air B200 into a crowded market, and a space Garmin clearly owns with the G1000 NXi retrofit. To date, Garmin says there have been over 500 G1000 King Air systems installed. Rockwell Collins also developed the Pro Line Fusion, which has three 14.1-inch widescreen displays that have both touch and cursor-control functionality. The market still waits for Sandel Avionics to bring its modular-design Avilon flight deck for King Airs. While that project seems to have gone quiet, Sandel says it's still working on it and maintains that the installation effort (and costs) will be sizably curtailed compared to anything the market has seen to date. While Sandel is hardly a stranger to the EFIS market, it will depend on shops to embrace it, and the same goes for the AeroVue.

BendixKing is currently building a dealer network that's qualified to tackle the major installation required of the AeroVue. There are eight approved dealers in the U.S. as we go to press and BendixKing is targeting a four-week install time for a typical B200 retrofit.

It's impossible to nail project pricing, since there are options for weather radar, TCAS, the AeroWave cabin Wi-Fi system and XM Weather, but typical fly-away prices might be in the $450,000 range.

BendixKing says it's working on more STC approvals, but it is not saying for which aircraft. There are plenty of TBM, Pilatus and other first-gen turboprops equipped with BendixKing EFIS 40/50 systems and based on the system I flew in the King Air, I think the AeroVue could be a good fit.

Contact www.bendixking.com.



The AeroVue retrofit can ultimately shave as much as 150 pounds from older King Airs like the B200 shown in the top photo. It also enables removing the complex AC inverter system used in some models, in favor of a more traditional DC avionics bus, bottom.

Replacement Plastic: Lower Prices, More PMAs

It's finally a buyer's market for aftermarket interior and exterior plastic parts. Vantage Plane Plastics has the largest selection, but there are plenty of others.

by Jim Cavanagh

CHECKLIST

- The quality of aftermarket plastic will likely exceed what was offered by the OEM.
- Cooperating competition is keeping prices within reason and inventories well stocked.
- Some components will require trimming, drilling and painting. Know what you are buying.

When we looked at the market for replacement interior plastic components nearly five years ago, prices were inordinately expensive. But recent research (including visits to several suppliers) proved that prices are falling and it's easier than ever to get high-quality replacements for worn and broken plastic parts.

The reason for the shift is partly because suppliers are earning more FAA PMAs (parts manufacturer approval), while pricing is based more on actual cost rather than inflated OEM pricing. But shopping for replacement plastic—especially for an aging interior—can be a complicated task. Here's what to expect and how you might choose a supplier.

A HARD LIFE

The common thread in the aftermarket plastic business is the dwindling OEM support for replacement plastic parts for legacy aircraft. One exception is Piper, which has made an effort to get tooling to aftermarket shops for proprietary parts manufacturing. And since these airplanes are still active, that's good news for the aftermarket suppliers and for competition.

Thanks to the handful of companies doing this, there are plenty of available replacement parts. Moreover, all of the companies we researched focus on building the parts that are most prone to breakage and unusual wear and those that get replaced most often. Yes, aircraft plastic lives a hard life and a quick look around your own aircraft—inside and out—will reveal problem components.

Plastic has been used by OEMs for interior and exterior components for decades because of its cost, weight and ease of fabrication. Fiberglass gained popularity as some parts are intended to handle structural/aerodynamic loads. Jim Bede used fiberglass for wing root and tips to compensate for passenger weight, and because he saw Cessna and Piper wingtips getting trashed by hitting airport fences and other ground obstacles.

The problem with all plastic parts—interior and exterior—is they eventually become brittle due to UV light. Some older plastics used in legacy aircraft have the consistency of tortilla chips and some had been pulled so thin in forming that you could almost read through them. Others just wear out naturally or by human handling.

Elevator tips, window trims, door panels and plastic parts that need to be removed for annual inspections might live the hardest lives, while others wear prematurely because they are prone to vibration. Parts that stick out might get hurt the most, and landing legs and fairings take a beating. Luckily, plastic parts can be repaired and some damage can be hidden, but eventually you run out of washers big enough to hide cracked or oversized holes. There's no set lifespan for a given piece of aircraft plastic, but in general about every 20 years or so most plastic has degraded enough to require replacement. On the other hand, we've seen 40-year-old aircraft with original plastic components that look they just rolled off the factory floor. For preserving interior plastic,

That's a plastic overhead panel on a CNC cutting machine in the photo to the left.

using cabin sun shields and covers is a huge help.

So while many plastic components aren't structural by design, can you remove and still operate the aircraft without them, as many do when a broken plastic part breaks? Legally speaking, not always. Every certified aircraft has a type certificate data sheet and if a part is installed on the airplane when this sheet is generated, then legally that part has to be on the airplane. Does it make a difference aerodynamically or with regard to safety? Not always.

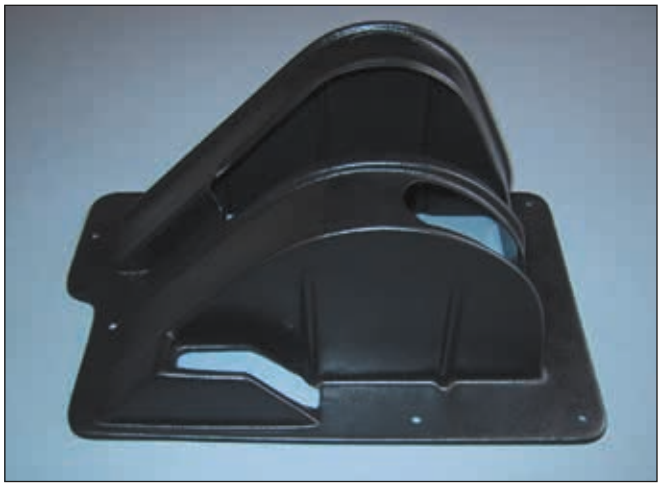
A missing upper strut fairing isn't going to hurt much, but it does open the attaching hardware to the elements and contact, plus it was likely on the aircraft during its final certification. Sure, there is nothing in the regs about how the parts look cosmetically, so some field repairs and touching up is perfectly legal. Break out the epoxy. Replacing plastic parts that are non-structural and that do not require the disassembly of a critical or structural component is perfectly legal under the approved owner maintenance list prescribed by the FAA, as long as simple requirements are met. Do the research before getting involved in the repair.

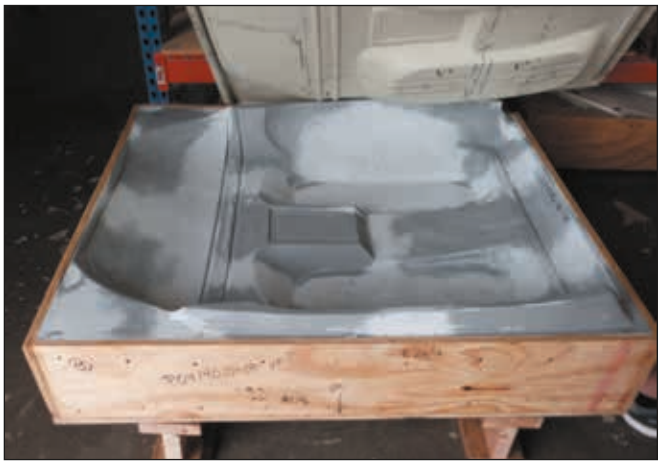
A CROWDED AND COMPETITVE FIELD

There are over a half-dozen major suppliers of aircraft plastic components (some specialize in interior parts), and that doesn't include the smaller shops that dabble in specialty plastic parts and mods. When you do a web search for airplane parts—interior or exterior—prepare for a lot of comparison shopping. It's an interesting and competitive industry.

From our experience, most of the competition know one another and have worked together at some point. Competition is keen, though, and the major players have spent years and millions of dollars to build manufacturing capabilities, earn PMA approvals and in our sense try hard to offer parts at reasonable costs, compared to OEM offerings. In reality, from a quality and price standpoint, they are actually the best watchdogs for the industry.

As mentioned earlier, the pricing structure of plastic parts is not always based on how much plastic is in the part or, as was the case decades ago, what the OEM charged for the part. The aftermarket companies have (based on our research) developed pricing structures that reflect the actual development and manufacturing costs for a part, and tossed in the certification costs based on a potential number of unit sales anticipated. This benefits the customer to no end.





The precisely manufactured instrument panel overlays in the top photo are from Plane Parts. That's a flap handle trim cover for a Piper in the middle, and one of the larger molding tools for an overhead panel, bottom.

A couple of the businesses we visited build parts for the OEMs using their proprietary tooling and materials, and just looking at the tooling would explain why OEM prices are so high. It is quite well-engineered and built for a long life. How? Some molds are cast aluminum and most are a mix of resins that stabilize over time. Describing them as heavy is an understatement. The shops that use OEM tooling are forbidden by contract to use the tooling to make parts they sell to the aftermarket. On the other hand, if you consider that most aftermarket parts tools are made from OEM parts, suppliers certainly have access to accurate parts that they

SAMPLE AFTERMARKET PARTS

DESCRIPTION	PRICE	SOURCE
CESSNA CARDINAL WINGTIP	$812	TEXAS AEROPLASTICS
PIPER PA28-SERIES OVERHEAD CONSOLE	$242.54	TEXAS AEROPLASTICS
PIPER PA32 INTERIOR WINDOW TRIM ASSEMBLY	$61.12	PLANE PLASTICS
MOONEY M20J REAR HAT RACK PANEL	$89.64	PLANE PLASTICS
CESSNA 150 LANDING GEAR FAIRINGS	$128.92	PREMIER AEROSPACE (P.A.S.T.)
CESSNA 182K INTERIOR DOORPOST	$99.99	PREMIER AEROSPACE (P.A.S.T.)
BEECH BONANZA DORSAL FIN FAIRING	$421	KNOTS2U
CESSNA 172P NOSEWHEEL PANT	$469.80	STENE AVIATION
CESSNA 206 STRUT CUFF	$118.12	STENE AVIATION

can reverse engineer. There are also a number of tools that have been purchased from the OEMs. When the decision is made to cease supporting a certain part, they sell the molds. This works for the OEM, the customer with a legacy plane and the shop. It also virtually guarantees the exact fit of the parts.

From a materials standpoint, the new plastic part has to be made of the latest fire-rated materials available, which has been the case since the 1990s. Most parts are pulled from .090 ABS plastic and some, as required by the original aircraft type certificate, Kydex, which has enhanced fabrication qualities and flame retardancy.

SOURCING YOUR PARTS

There are essentially seven major players in the replacement plastic parts business, including Vantage Plane Plastics (www.planeplastics.com), Knots 2U (www.knots2u.net), Texas Aeroplastics (www.buyplaneparts.com), Premier Aerospace Services and Technology or P.A.S.T. (www.premier-aerostore.com), Plane Parts Company (www.planeparts.com), Stene Aviation (www.steneaviation.com) and Mapleleaf (www.aircraftspeedmods.ca). In our prior research we found two more, but Globe Fiberglass was purchased by Knots 2U, while Heinol and Company was purchased by P.A.S.T.

We found that Vantage Plane Plastics has the largest inventory. It is part of Vantage Associates, a California aerospace conglomerate that does vacuum forming, among other things, and the general aviation division is in Alva, Oklahoma. Plane Plastics was once Kinzie Industries, a small company that built parts for Schweitzer Helicopters. When the company purchased a Cessna that needed replacement plastic it built it and eventually began pursuing this business. The plastic forming portion of the business was sold to Vantage Inc., which changed the name to Plane Plastics. The company houses over 4000 tools, has over 3000 PMAs and the company builds a number of parts for Cessna.

Dale Logsden hosted us on a visit to the huge Plane Plastics facility and admitted that the company had fitment problems in its early days. A longtime pilot and mechanic, Logsdon explained that originally the management was more interested in having the largest catalog and put more effort into finding parts to use as models for tooling than ensuring proper fit. Eventually it realized that once you build a part, it needed to be trial fitted, modified, rebuilt and trial fitted again until it was right. Toward the end of the Kinzie reign, this practice was started and has continued through the Vantage years.

Building a plastics tool is no easy chore. We watched the tool guys at Plane Plastics for a while and can attest that it's time-consuming work. Some of the tooling can weigh well over a thousand pounds. The build process has to allow for thinning of the material as it is stretched over the tool, plus the shrinkage that comes as the newly formed part cools. (Science 101: Things expand when heated and shrink when they cool.) Plane Plastics and most of the other shops use new materials that have minimal if any shrinkage over time.

Over the last few years, Plane Plastics reduced the price on most of its parts. We were told that it took a good look at aftermarket plastic parts throughout the industry and realized they were just too expensive. Having based their prices on the old Kinzie catalog, they reviewed the actual production costs and re-priced the parts accordingly. This price reduction—and a continued effort to ensure quality and fit—makes Plane Plastics perhaps a volume leader that focuses on one-stop shopping. It sells parts, materials and paint, plus it offers cabin noise reduction kits and carpeting.

Across town is Premier Aerospace Services and Technology Inc. or P.A.S.T. Scott Brown is the president and co-owner of this youngest of plastics companies. Brown and his colleague, Bryan Powers, originally worked with Kinzie, then Plane Parts, and finally started off on their own to focus on OEM contracting. They did this for a while before expanding to build their own PMA parts. P.A.S.T. purchased Heinol and Company, which built parts for Piper. Al Heinol honed skills in the auto industry and was responsible for submitting nearly all of the Heinol parts for FAA certification. The company still does contract work for Cessna and Cirrus.

P.A.S.T. gets by with just a handful of workers. We saw its large vacuum tables that make parts from full sheets, and a small table to save time and space and for low-volume parts. Being efficient with raw materials is an important aspect of its pricing structure. The company tries to keep a six-month supply of parts in stock. Brown told us the goal is to certify 10 new parts per month, adding to its already impressive inventory. In our research we found that its parts quality and pricing structure is right in line with other shops.

KNOTS 2U, PLANE PARTS, TEXAS AEROPLASTICS

For years, Wisconsin-based Knots 2U was known as a high-quality speed mods shop. When the company was

sold to John Bailey, he realized that if the company was to grow it had to expand its business. Since it already made PMA mod parts for a number of Piper models and some Cessnas, Bailey began to make and certify some of the more popular replacement parts needed by Cessnas and Pipers and eventually added other brands. The company created a catalog, fattened the inventory and as business increased, it began buying smaller companies (including Metco for stainless steel cowl fittings), plus a door seal company.

Bailey told us that between its own development and the purchase of other companies it has allowed for nearly 50 new PMA approvals every year, and there were 30 in progress as we prepared this report.

Worth mentioning is that Knots 2U is fortunate in being close to a big city ACO (Chicago), which also has a track record for setting records in approving PMA applications. Still, in our experience the company is diligent in sustaining a high standard of manufacturing, materials, workmanship and fit. Bailey's own parts are just a portion of the catalog, but with the purchase of Globe Fiberglass, plus herculean efforts to redo the tooling for reduced weight and better fit, his own brand of composite parts is of unquestionable quality, in our view.

Roanoke, Texas-based Texas Aeroplastics has been around since 1981 and has an extensive inventory of Cessna and Piper replacement ABS plastic parts, which are thicker and generally more durable than many OEM components. For a fee, the company will paint exterior pieces to match your current paint work—something to consider when replacing any plastic part. The company provides parts for Beech, Grumman, Cirrus and Rockwell airplanes, as well as many Van's RV models.

All parts for certified aircraft are FAA PMA approved, plus the company keeps a good inventory and is ready to ship same day. Its prices have remained the same over the past few years. Texas Aeroplastics employs only six people and is in the process of moving to a large, off-airport facility.

Los Angeles, California-based Plane Parts Company specializes in Piper interior plastic parts. Owned and run by Bob Adkins and his wife, the company was started in 1992 after Adkins needed replacement plastic parts for his own Piper Cherokee. He was appalled by the prices he paid.

Fiberglass components require more man-hours, top photo, which means higher costs. The interior components shown in the bottom photo are ready to ship, but notice they'll need to be painted before you install them.

Plane Parts is different from the competition in that it subcontracts manufacturing to a local company that uses CNC technology to make and trim the parts. The company focuses on selling parts that suffer the most attrition and has a bit over 100 PMA'd parts in its catalog.

Plane Parts can ship many parts the same day if the order is in early enough. Atkins told us that the return rate on parts has been less than 1 percent in over 25 years of doing business and the pricing has remained stable for quite a while now. Some (but not all) of the parts are pre-drilled or dimpled because many OEM parts that had holes or dimples did not match the structure. He tells us that very few Piper original parts actually have precisely jigged holes and that all OEMs' window and upholstery trim pieces are installed individually as they went down the line.

Installing them yourself? His suggestion is to use a #4 stainless steel truss head screw and a nylon washer and simply shoot through the plastic into the flange, careful to avoid structure, electrical wiring and static system plumbing. It isn't necessary to pre-drill the piece because according to him, the new plastic will not crack.

From what we saw, the engineering and attention to detail is evident in the product's fit. None of the parts are copied from damaged or new surplus ones due to the shrinkage of plastic over the years. It uses newly manufactured parts as templates and test fits them to multiple aircraft. If necessary, the new part is refined until an exact fit is accomplished before

PRICE SHOPPING? CAVEAT EMPTOR

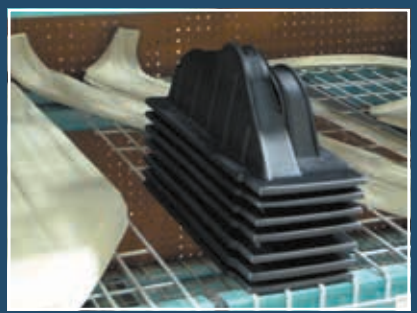
When it comes to pricing, we have found that the buyer needs to be aware of what he or she is getting. For example, if a part is available in plastic from one vendor and fiberglass from another, the fiberglass will be more expensive. In some cases, it is quite a bit more expensive, and in others not so much. It's really the amount of labor that makes the difference, and of course, the fiberglass part will likely last a lot longer and should be considered if the part is a much used or abused item.

Considering that there are a kazillion parts out there for most all aircraft, a buyer can expect that different companies will make different parts and all prices come from God-knows-where, so a good deal of research time online or on the phone is in order. Doing an across-the-board comparison of all fabricators is difficult. We had fits doing so and finally gave up our search for a hands-down price winner. But specialty shops might seem to charge a premium.

When looking for interior parts, Plane Parts Company in California only does interior parts, manufactured using a CNC process. Based on our research, its prices averaged out to being a few dollars more per piece, but their promise of having a more accurate fit might be worth the extra money for some.

Along those same lines, you should understand that not all shops will have the same inventory. For example, Vantage Plane Plastics is big on interior parts and is in the process of expanding its exterior parts inventory and simply may not have what you need.

In an effort to get a true price



comparison, we tried to choose some random parts that should be available for certain models, but found that this isn't always the case. When you factor in that Knots 2U, P.A.S.T. and Texas Aero Plastics have combined to ensure that a customer gets a part, there is duplication of a number of parts in all three catalogs and in many cases, the prices are the same. For example, the later style overhead console for a Piper Archer is $242.54 from all three companies, and it's likely that just one of them makes the component. This works for their catalogs and all three companies have gaps in their inventories that the others can probably fill, so in the end the customer really is taken care of.

This might help a buyer who's sourcing a number of parts at the same time. He can determine which company has the most parts available and can price out all of them. If one company is more efficient—perhaps in infrastructure and labor—the total package would reflect a greater economy.

During our research we did find a number of random parts that were priced pretty close across the board. A lower strut fairing for a 1974 Cessna 172 is $66.05 at Vantage Plane Plastics, $72.91 at Texas Aero Plastics and $72.91 at P.A.S.T. The passenger door window trim for a 1980 Skylane is $138.27 at Vantage and $136.54 at Texas Aeroplastics, but wasn't available from P.A.S.T.

Still, it pays to price shop. The center floor console for a 1975 Skylane was $213.94 at Vantage and $163.39 at Knots 2U. That kind of savings pays for the freight—and then some.

building the tooling. While the company's pre-drilled and trimmed parts might seem higher priced than others, there's a definite value in installation time savings, in our view.

Stene Aviation in Polson, Montana, specializes in composite exterior Cessna parts. It has over 300 PMA'd components for Cessna models (the 150 through the 337) made from lightweight, flexible "E" glass material that conforms well if there are dimensional vagaries. Stene recently received FAA approval on a line of parts for Piper models. Owner Will Stene told us the company will be rolling out composite landing gear doors and new nose bowls for Cessnas. It has worked closely with AeroLEDs to produce the Quasar LED CX wingtips with integrated landing, taxi and recognition lighting.

Last is Mapleleaf Aviation in Canada, which specializes in fiberglass parts for Cessna models. We mention them mainly because their parts aren't exactly like OEM parts—they're modified and considered speed mods—so be sure there is an STC in place and the parts come with FAA paperwork.

THE FUTURE LOOKS BRIGHT

An interesting development in the aftermarket plastic parts business is a handshake agreement between three of the major players to work together. There is nothing formal and they are not partners, per se, but Knots 2U, which is growing hand-over-foot and is thickening its catalog by the month, along with Texas Aeroplastics and P.A.S.T., have joined together to carry at least a portion of each other's product line. This helps to create a one-stop shopping store. If one of them doesn't carry the part needed, they will send the customer to one of the other companies.

They still compete, of course, and they still run their businesses independently and have different philosophies, but to see this kind of cooperation in the midst of competing and growing their own businesses gives a sort of neighborly feel to the industry.

From a tech standpoint, we're glad to see these firms using more robust materials than the OEMs did. They understand the processes, shrinkage and the vagaries of vacuum forming. Better yet is lower prices and shorter lead times—proof that competition works for the buyer.

SpotX Messenger: Robust, Sized Right

Spot's latest-gen personal satellite communicator has a logical feature set, a sunlight-readable display and a customizable SOS function.

by Phil Lightstone

Thanks to the internet and cellular telephone networks, ground communication services have become an expected component of preflight briefings, the filing of flight plans and for staying connected in the cabin. Within urban areas, telecommunications networks are as ubiquitous as water, although we accept that performance is limited by altitude.

But the reality is entirely different when flying in remote regions of North America, where coverage is patchy and broadband networks are akin to drinking through a straw.

Portable satellite communicators attempt to fill these gaps and the latest two-way comm is the $250 SpotX, positioned to compete with Garmin's InReach Mini, which we reviewed in the July 2018 *Aviation Consumer*. Here's a field report on the SpotX.

THE NETWORK, HARDWARE

Low Earth Orbit (LEO) satellite constellations (Globalstar, for the Spot products) complement ground-based systems and in many locations provide the only available service. Accessible from most parts of the planet, Globalstar's LEO network provides ubiquitous communications—data, voice and internet services—although at much slower speeds than traditional terrestrial networks. GPS positioning and a ground station network connect the signal to the device.

The current-gen Globalstar LEO system typically provides for 1 Mbps connectivity, which works for voice calls (typically at 90 Kbps), plus text messaging and short emails without attachments. Don't expect bandwidth-intensive apps, including weather graphics, to work well via satellite. But portable messengers can work well for search and rescue purposes, which includes SOS.

Spot boasts that its communicators (first released in 2007) are responsible for over 6000 saves—over 3000 in the U.S.

Designed for the outdoors, the device is waterproof, shockproof, sports a sunlight-readable 2.7-inch (non-touch) screen and weighs 7 ounces. The keyboard is backlit and I found it easy to type with—important in the airplane or anywhere.

SpotX is powered by a rechargeable lithium polymer battery and includes a Micro-USB cable and AC/DC charger. A full charge can be achieved overnight. The hardware is designed to operate in temperatures from -4F to +140F (-20C to +60C) and conforms to the IP67 ruggedized hardware specifications. It's submersible up to 1 meter for 30 minutes.

The device has sufficient storage to hold up to 70 contacts and/or contact groups. A rocker style cursor pad (called the Directional Pad) allows the user to navigate between menu pages and make selections. The key in the center of the Directional Pad serves as the select key.

SpotX is assigned a telephone number for your appropriate country during activation. This allows contacts in the same country to send SMS messages to your SpotX without incurring any additional fees. There are four key components to the SpotX product: the SpotX hardware, its activation and service plan, its configuration through the website and the SpotX Device Updater application used to synchronize account information and update firmware. As we've learned from other satcomms, setup and activation can be a chore. For the SpotX, it begins with setting up an account on the FindMeSpot website from a Mac or PC, requiring a credit card for payment and information about your hardware.

The SpotX, right, has a rugged build quality and QWERTY keys that are large enough for efficient typing.

CHECKLIST

- Using the SpotX for SMS texting and short emails is reliable enough to be useful in flight.
- Designed for stashing in a pocket, it has a good keyboard and the menu structure is shallow.
- We think the SpotX could be even better if it had a touchscreen interface.

With a footprint that's reminiscent of an older Blackberry device, we think the SpotX is sized right for the hand and for use in the cockpit. But, use caution in placing the device in close proximity to GPS receivers.

With your account set up or logged into, three steps are required. The first is setting the serial number and authorization code of the SpotX hardware and a device name. The second step—an important one—is selecting the country because that determines the mobile telephone number of the device. The nuance is additional charges may apply when texting from your SpotX to international telephone numbers (like sending a message from your U.S.-registered SpotX to a French mobile device). Finally, select a service plan and payment information.

Once the activation process is completed, the system will take you to the My Devices page on the website. The user's and quick-start guides can be downloaded from this page. This page will also indicate the last time the hardware was synchronized and whether there is a firmware update required for your hardware. It's important to keep it updated. Another important step is adding your contacts (and groups), SOS and Check In outgoing messages and contacts.

SPOTX FEATURE SET

The device's menu structure is uncluttered and simple. At the top of the screen is a status bar where a number of icons are displayed, including the tracking mode, the current system time, the number of messages waiting to be sent, satellite connection and a battery indicator. The status bar also is a handy way to determine if your message has been sent.

The main screen includes the Message, Check In, Social (social networking), Fetching New Messages, Tracking, Navigation, System Settings and SOS menu icons.

The Check In selection sends an SMS text or email to a list of contacts. The contents of the message and the SMS/email lists are controlled through your web account. Once the email or SMS is received by the recipient, they can simply open the email and click a link to either the FindMeSpot map page (powered by Google Maps) or directly to Google Maps.

When SpotX is powered up, tracking is disabled by default. The Tracking menu displays the current tracking interval, allows the interval to be changed and turns tracking on and off. A higher tracking interval (2.5 minutes versus 60 minutes, for example) will use more battery (and has a higher monthly fee). It will run for 10 days in the 10-minute tracking interval mode.

I have found that placing my SpotX on the glareshield of the aircraft presents a clear view of the sky to the device. Spot recommends that the device be placed at least 12 inches from a GPS navigator and I have yet to experience adverse interference with the GPS navigators in my aircraft—a G1000-equipped Cessna Skylane.

On a side note, another user reports that the SpotX was unusable in his Aviat Husky, which is a fabric airframe equipped with a Garmin navigator and an ADS-B transponder. After confirming the SpotX was the source of the GPS signal problems, he replaced the SpotX with a Garmin InReach, which works fine in the Husky.

To send a message, simply select the Messages icon (using the cursor) and press Enter. The page has five menu options: Message (to compose), Contacts, Predefined, Fetch Rate and Cancel Messages. Selecting Messages will display a list of all messages (both SMS and email) that were sent and received. To compose a new message, scroll down to the bottom right hand of the page and select the Pen icon. This will take you into the message composition page. "To" is highlighted and using the button in the middle

SPOTX AT A GLANCE

Dimensions: 2.04 x 3.90 x 1.0 inches

of the Directional Pad opens the Select Contact page or you can scroll over to the Contacts icon on the far right of the screen. Use the Directional Pad to scroll down to select a contact and the press the middle key to select the contact. The contact's email address or SMS address will be displayed as separate contacts in the list. Once contacts are selected, scroll down to Message, which will navigate you to the New Message screen, and begin typing your message. Various fonts can be selected, including bold and italics, to highlight your message. A message may be up to 140 characters. The Send Message icon (lower right of the screen) is used to send the typed message. Remember, the display is not a touchscreen—all cursor movements are controlled by the Directional Pad.

SMART SOS

SpotX will drop electronic breadcrumbs (EB) along your route of flight with a drop resolution of 2.5, 5, 10, 30 or 60 minutes, depending upon the service plan and when tracking is enabled. For pilots flying on a VFR flight plan or itinerary, EBs provide a time-efficient technique for Search and Rescue (SAR) teams to execute a search in the event of an overdue aircraft. You can provide access to Leidos Flight Service (formerly Lockheed) through embedding the SpotX Share locations into your flight plan.

The initiation of a rescue begins with pressing the SOS button, which is behind a protective cover prominently marked "SOS," or through the SOS icon on the main screen. Once activated, the SOS icon will be displayed on the status bar and the SOS notification message will be sent every 2.5 minutes until it is acknowledged. SOS may be canceled one of three ways: powering off the device, pressing the SOS bezel key for three seconds and following the onscreen instructions or by selecting the Cancel SOS command.

The SpotX sends a notification with the device's GPS coordinates to the GEOS worldwide monitoring center (www.geosworldwide.com). GEOS provides SOS monitoring and emergency dispatch through its dedicated International Emergency Response Coordination Centre (IERCC) based in Houston, Texas. The IERCC is staffed 24/7 with trained personnel who have access to first responders. The average response time from the receipt of your SOS message until referring an emergency responder is 11 minutes. You may be liable for additional charges if you send a false SOS message. In countries where search and rescue services are provided on a fee basis, you can upgrade to the GEOS Member Benefit for reimbursement of up to $100,000 in SAR expenses at an annual cost of $24.99.

Once an SOS message has been received, the IERCC calls your emergency contact(s) to determine if it is a false alarm. It locates and notifies an emergency responder and then maintains an open line of communication, including providing updates of your location. The IERCC will also keep your emergency contact(s) informed. SAR leaders believe that when stranded in remote regions, two-way communications contribute to a positive state of mind, which improves survival outcomes.

Tracking resolution is an impor-

continued on page 32

Prop Inspections: More Than Surface Flaws

There are good reasons why the FAA is serious about propeller maintenance. Performing the right inspections and repairs is key to long service life.

Staff report

Those rushed preflight walk-arounds are all the same—the hand makes a quick pass over the prop's leading edge and then it hits the starter switch—you not really knowing if the propeller is airworthy. We've been there.

Want a better respect for propeller inspections? Read NTSB reports written about propellers coming off in flight—they aren't pretty.

To supplement shop-performed prop inspections and maintenance, there are plenty of things an owner can do during service to keep the blades turning safely for a long time. We'll mainly concentrate on inspection and repairs for metal props here, but offer tips for wood and composite props, when appropriate.

BASIC INSPECTIONS

A propeller and its systems are more complex (and critical) than you might realize, evident by the detailed inspection procedures prescribed by the prop manufacturer. The good news is there is a lot of inspecting that can be done without even removing the blades from the aircraft. The FAA's advisory circular AC 20-37E is worth a read as it provides guidance for aircraft propeller maintenance. In particular, the AC provides information and suggests procedures to both increase service life and to minimize failures of metal propellers. Wood and composite props generally follow different repair guidance.

If your tool collection doesn't include a high-quality magnifier, get one and a good work light. In addition to pitting and corrosion, you'll be checking for maintenance-induced problems like missing safety wire and cracks around the attachment bolts, which happens when the bolts were overtorqued. But start with the basics—the right way.

That's the rear pusher prop on a Cessna Skymaster pictured to the left. There's plenty to inspect.

At the very least, you should be performing a visual preflight inspection of the blades for nicks, scratches, dents, erosion, corrosion and cracks. Apparent damage should be referred to an appropriately rated mechanic because a crack or bend, as two examples, are cause for removal of the propeller.

You can check the propeller spinner attaching screws for security and check the spinner for damage, as well as for evidence of oil or grease leakage. Don't be afraid to clean the propeller blades periodically using fresh water, a non-alkaline cleaner and a soft cloth or soft brush. Dry with a soft cloth.

If the aircraft (or prop) is new to you, this is also a good time make sure that the applicable installation, information and warning decals are on the propeller. These decals may include warnings against pushing or pulling on the prop, the model number, the correct bolt torque, dynamic balancing information and any other manufacturer's identification.

While you're at it, conduct a functional check including RPM control, RPM limits, idle setting, responsiveness and vibration. Of course, you have to start with a calibrated tachometer. We added an optical tachometer to the flight bag years ago and it was one of the best investments we made. Sporty's currently sells the battery-operated TruTach II optical tach for $225, which is accurate to within 1 RPM and works with up to five propeller blades. Simply hold it above the glareshield, point it at the prop and compare its reading to the aircraft's tachometer. Tachometer inaccuracy could be a direct cause of propeller failure and excessive vibration.

When parking the airplane, move two-blade metal propellers to the one o'clock position to minimize bird droppings and water retention in the spinner. Wood propellers should be stored in the horizontal to prevent moisture accumulation in one blade, which would cause unbalance.

Last, be mindful of the surrounding area and surface conditions. Do not run up engines in areas containing loose rocks, gravel or debris. Avoid quartering rear winds during ground

runups because this can cause damaging stresses. Do not push or pull on propeller blades when moving the aircraft by hand. If you must, grab on to the blades as close to the hub as possible.

Wood and composite propellers are susceptible to internal damage from small stone strikes that can create delamination or micro cracks and permit intrusion of moisture or damage to metal protection. When inspecting wood or composite propeller blades, look for cracks or delamination on the blade surface and at the edges of the blade. On wooden propellers, check the glue lines for debonding and look for warping and loss of protective coating or protective metal edge damage.

UNAPPROVED REPAIRS

If your preflight inspection of the propeller does reveal questionable damage, resist the temptation to fly the aircraft—even to bring it to the shop. Simply have a mechanic put his or her eyes on it to determine if it might need to come off the airplane. And if you hit something—even a rubber parking cone—don't fly the aircraft without having the prop inspected by a mechanic. We know one pilot who admitted to hitting a cone, but still flew the airplane on a 400-mile trip—at night, in the weather—to find out one of the three blades was loose in the hub. He wins the Darwin award.

We also know pilots who attempted to straighten a bent propeller. This is a setup for doing more (often hidden) damage. There are some pretty crude unapproved repairs made. Never repair any blade defect by welding, heating or peening. Propeller manufacturers do not permit this because it can induce premature blade failure.

Do not fill any damaged areas of metal blades with bulk filler materials such as epoxy or auto body fillers. This prevents areas of potential cracking from being inspected. Consider that filling a damaged area will not correct the stress risers caused by the dent or those caused by the loading that introduced the dent. Also, do not paint over areas of corrosion on blades—even with rustproof paint. Corroded areas should be removed in accordance with approved procedures prior to applying the approved protective finish.

When it comes to cracks, they may be present in the hub area between or adjacent to bolt holes and along the hub pilot bore. Cracks in these areas cannot be repaired and require immediate removal of the propeller.

Don't underestimate the importance of inspecting the spinner, top photo. It can come off in flight, with ugly results. The four-blade composite prop on the Cirrus shown at the bottom has an STC for retrofit. Notice the erosion strips on the leading edges of each blade. Don't install any prop modifications that aren't approved for your airplane.

Since propellers create stress to the surrounding structure, look past the prop for cracks and missing hardware—especially on the cowling.

COMMON DAMAGE: TIPS

Blade tip damage is perhaps the most common and the manufacturer's maintenance documents generally have instructions for repairing it. But if the prop manufacturer doesn't publish the repair information, there are specific procedures to follow for repairing nicks, dents, pits and cuts in the propeller's tip. But you still need to consult manufacturer's data. For example, any removal of the blade tip material that reduces the blade radius below the minimum specified for the propeller manufacturer's model designation and specific installation criteria is not permitted. Other damage, including cracks in the blade, might be spotted during the repair. Keep in mind that cracks can't be repaired. Moreover, the presence of a crack pretty much indicates that blade failure is imminent and cracks on the leading and trailing edges are especially prone to propagation.

Blend-outs or repairs should never be attempted on these cracks. The

FAA PLAYS HARDBALL WITH SENSENICH PROP SERVICE

Proving that it takes propeller maintenance seriously, the FAA last month issued an Emergency Order revoking the repair station of Sensenich Propeller Service (the FAA order does not apply to Sensenich Propeller Company, although the two originally shared ownership). The FAA alleges that the popular propeller repair and overhaul shop, located in North Windham, Connecticut, knowingly and intentionally performed maintenance on 47 McCauley propellers for 45 separate aircraft that was contrary to instructions provided in the manufacturer's overhaul manuals. The FAA further alleged that Sensenich and its accountability manager certified (signed off and returned to service) that the work was done in accordance with the manufacturer's overhaul manuals and FAA regulations when company officials knew the props weren't properly overhauled.

In the Emergency Order, the FAA alleges that the workers overhauling the props failed to perform a spring-load test or replace the propeller return springs, as required by the manufacturer's manual. The shop didn't own the equipment necessary to test the spring loads, the FAA says, and managers told employees to reuse the springs without doing the test as long as they passed the required limits on visual and nondestructive testing. The shop then approved the propellers for return to service, the FAA says.

The FAA document also cites a number of instances when the shop failed to replace springs, retaining rings, studs and screws, as required, and nonetheless approved the props for return to service. If you're concerned that your prop went through this shop, the FAA alleges the violations occurred between March 2015 and at least February 2017.

The company didn't respond to our request for comment, but the FAA says both the repair station certificate and the repairman certificate of the accountability manager have been surrendered without appeal.

prop must be removed from service and identified as unairworthy. If the manufacturer did not publish guidance, any authorized repair to the propeller tip should be inspected with a minimum 10X lens to ensure that any sharp notches at the bottom of the damage have been removed.

For leading/trailing edge damage, if the manufacturer did not publish information to the contrary, some repairs can still be made. For nicks, dents, pits and cuts in the leading or trailing edges of blades, ensure that the bottom of the damage is removed first by rounding out and fairing in the repair only slightly deeper than the damage. Initial removal of material should be done using a fine cut file.

All traces of file marks in the repaired area should be removed with #240 emery cloth followed by polishing with #320 emery cloth and then finished with crocus cloth or 600-grit emery cloth and then visually inspected. An individual edge repair should not exceed a depth of 3/16 inches. We've seen far too many amateur repairs done with coarse metal filing, which leads to stress risers and eventual failure.

For gouges, cuts and small dents on blade faces, ensure that the bottom of the damage is removed first by rounding out and fairing in the repair to form a saucer-shaped depression only slightly deeper than the damage. The initial repair should be accomplished by filing with a fine cut file parallel to the damage and finishing with #240 and #320 emery cloth, as in the manner of damage removal from blade-leading edges.

Even more substantial damage might not render the prop a total loss. Limited repairs may be made on propellers by appropriately rated maintenance technicians either on the aircraft or when the propeller is removed. Minor dents, cuts, scars, scratches and nicks may be removed providing their removal does not weaken the blade, substantially change weight or balance or otherwise impair performance. In the end, it's best to leave the inspection and repair of more substantial damage to a certified and respected propeller shop.

PROP BALANCING

Props can become unbalanced for a variety of reasons, including mishandling. Unauthorized or improper repair of spinners has also been identified as a cause of propeller imbalance. It's not rocket science; an unbalanced condition occurs when the mass of the propeller is not symmetrical around the center of rotation. When the mass is unsymmetrical, a radial force and/or out-of-plane moment couple is formed.

Static and common dynamic balance procedures only correct the radial force unbalance by adding an equal force in the opposite direction with balance weights. Only trained, specially equipped and authorized maintenance personnel should accomplish the dynamic balance procedures. There are two methods of propeller balancing—static balancing and dynamic balancing. Neither method can replace the other because they are used for different purposes.

A propeller can be statically balanced only by removing it from the aircraft and evaluating the balance on a special fixture. Only appropriately certificated persons or shops may adjust propeller static balance. Static balance weights are added to or removed from the propeller to correct the measured imbalance, or material from the blades is removed by special grinding techniques.

Dynamic balancing of a propeller is done to provide for the lowest level of vibration in its operating range. Although the propeller is the focal point of the balancing procedure, it is the combination of the engine mounting system and the propeller assembly that combine to provide the given level of vibration. There are a lot of variables.

In the end, if you've replaced or had a propeller overhauled you know it's a sizable investment. The only way to get long life from a prop is to operate it correctly and carefully, protect it from the elements (a prop cover isn't a bad idea for outdoor storage) and ensure that even the most minor repairs are done per the manufacturer's and the FAA's guidance.

uAvionix tailBeacon: ADS-B On The Tail

The uAvionix tailBeacon is the latest certified low-cost ADS-B Out option, but a patent lawsuit from Garmin could have potential buyers watching and waiting.

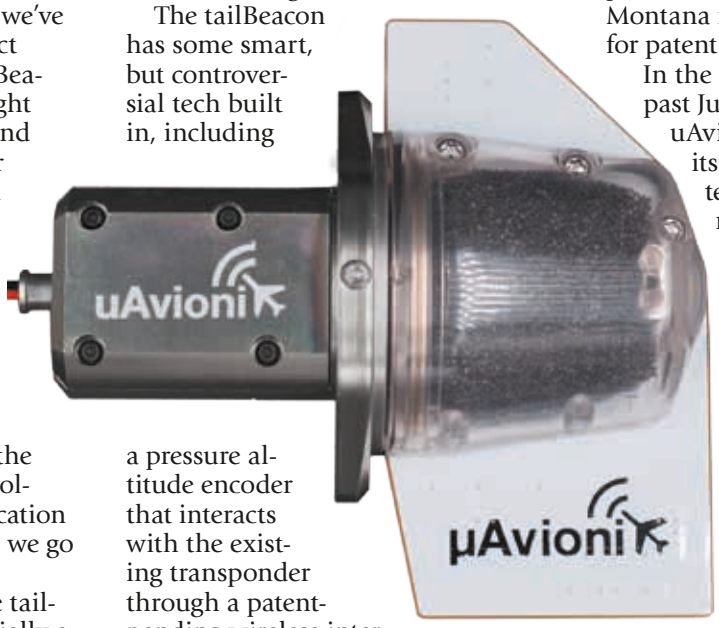
by Larry Anglisano

For almost two years the market has been dazzled as Montana-based uAvionix introduced smartly designed ADS-B mandate solutions that seriously curtail the installation effort and cost. As we've been reporting, the first product aimed at the masses is the skyBeacon, a wingtip LED position light with internal WAAS GPS, L-band antenna, an ADS-B transmitter and wireless Bluetooth. With a two-wire interface (power and ground) and a mounting footprint that's the same as many existing incandescent position light housings, the $1849 bolt-on skyBeacon is about as simple as ADS-B Out installs get. uAvionix has been selling the skyBeacon to the experimental market while it soldiered through the TSO certification process, which was awarded as we go to press.

The follow-on product is the tailBeacon, a product that's essentially a repackaged skyBeacon and is designed to easily replace tail-mounted position lights. Like the skyBeacon (and unlike most other ADS-B Out products) the idea is to side-step a big teardown installation by utilizing the existing tail position light wiring, the existing circuit protection and the existing mounting holes for the original light. But like the skyBeacon (which can't be mounted inside a wingtip fairing, for example), some installations will require more modifications when the light's base doesn't match the one on the tailBeacon's mounting footprint, although there's a good chance the existing wiring can be used.

In addition to an LED position light that meets TSO-C30c criteria, there's also a built-in anti-collision strobe, which will likely require additional wiring.

The tailBeacon has some smart, but controversial tech built in, including a pressure altitude encoder that interacts with the existing transponder through a patent-pending wireless interface that uAvionix calls a power transcoder reading pressure altitude and the current squawk code without additional hardware or wiring, although the power transcoder is not intended to replace the aircraft's existing altitude digitizer for Mode C functions.



The $1849 tailBeacon shown in the center photo is a follow-on to the skyBeacon and has LED position and anti-collision lighting, plus a full-up ADS-B Out transmitter and GPS.

Configuration and setup of the tailBeacon (and wingtip skyBeacon) are done through the uAvionix installer tablet app. Here you program the aircraft's call sign, ICAO address and anonymous mode, plus the app has a performance monitoring utility so installers can verify the system is working before launching on a test flight in ADS-B airspace.

uAvionix says a typical tailBeacon installation might be accomplished in around 15 minutes. Weighing 2.9 ounces including the 6-inch wiring pigtail, rebalancing the aircraft's rudder will depend on the weight difference between the existing light and the new tailBeacon, although in many cases the weight difference is less than 0.5 ounces, uAvionix said.

BUZZKILL

As we go to press, the black cloud parked over the uAvionix facility in Montana is a lawsuit filed by Garmin for patent infringement.

In the legal document filed this past June, Garmin alleges that uAvionix has taken/copied its patented AutoSquawk technology—U.S. patent number 8,102,301 (the "301 Patent")—without permission. Garmin's AutoSquawk curtails the installation and reduces equipment costs of mandate-compliant ADS-B Out upgrades because it eliminates the need to install a dedicated ADS-B control head for keeping the existing transponder's Mode 3/A and altitude data in sync with the ADS-B Out data. Other manufacturers' ADS-B equipment—including FreeFlight Systems and L3, to name two—require the use of a control panel and wiring for 978 UAT systems.

In an official statement, uAvionix denies infringing on Garmin's patent and says it has its own patent-pending method for using the transponder's Mode 3/A and altitude data that differs from Garmin's 301 Patent.

"We are disappointed and frustrated we have to go through the expense, distraction and effort of defending ourselves, but also recognize that disruptive products often attract

continued on page 32

Commander 112/114

Rockwell Commander piston singles are sturdy, comfortable travelers, but the 114 is the better performer.

These days you don't have to put your eyes on a model 112 or 114 Commander for long to see why these airplanes had perhaps more ramp appeal than the competition. At the time (somewhere around 1972) North American Rockwell remained true to its military contract experience and built big airplane touches into the small Commanders. Even well before the Commander singles came along Rockwell had been trying to bring the right mix of ramp appeal, features and performance to the general aviation market. The Lark, Darter and efforts to revive the Meyers 200 didn't exactly work out the way Rockwell had hoped.

But it connected with the Commander 112, thanks to a cabin with dual doors that emphasized easy ingress and egress (more appealing than the single-door arrangement on Piper and Mooney models), aggressive styling and a price just shy of $25,000. It was a rocky road for the Commander singles. A series of model changes ensued and original production ended in 1979. Since then, the design has been in and out of several hands, one pair of which actually produced some 200 updated models during the 1990s. Here's a look at the Commander 112/114 and what to expect and consider when shopping for one.

The Commander's stability and predictability make it a perfect IFR platform.

MODEL HISTORY

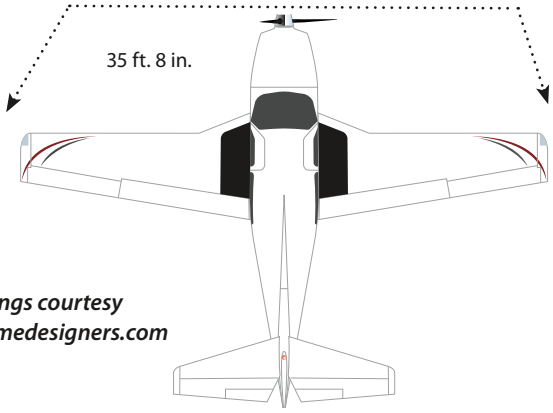
The Commander single series began life as the Rockwell 112, a 200-HP retractable designed to compete against Cessna's Cardinal RG, Piper's Arrow and Beech's Sierra. During its development, Rockwell conducted elaborate studies of pilot preferences and even aviation journalists (*Aviation Consumer* editors included) were invited to take a look at preliminary designs and make suggestions. The result made its debut in 1972 and emphasized looks, cabin room and comfort over raw performance.

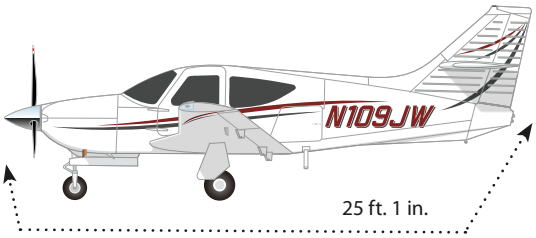
It turned out that despite the big cabin, the Commander 112 was quite deficient in useful load, resulting in the 112A model, which came out in 1974. The 112A featured an increased gross weight—from 2550 to 2650 pounds—at a nominal change in useful load. Owners tell us an early 112 can benefit from the 112A's increased gross weight after applying a service bulletin and a few dollars.

Squeezing even more load-carrying ability out of the airframe, Rockwell delivered the 112B in 1977, still powered by the same 200-HP Lycoming IO-360-C1D6 as earlier models. The 112B featured 16-inch

Gus Corujo filmed the Rockwell Commander 114 climbing out in the main photo. Notice the hefty trailing-link landing gear and custom paint work.

COMMANDER 112/114





25 ft. 1 in.

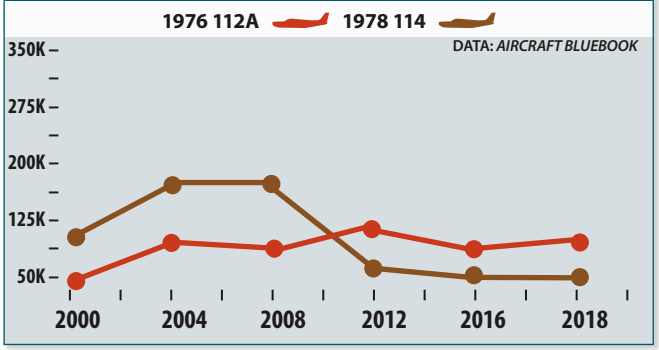
8 ft. 5 in.

Drawings courtesy
www.schemedesigners.com

COMMANDER MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1972-73 COMMANDER 112	LYCOMING IO-360-C1D6	2000	$28,000	60	1020 LBS	130 KTS	±$40,000
1974-76 COMMANDER 112A	LYCOMING IO-360-C1D6	2000	$28,000	60	1020 LBS	140 KTS	±$47,000
1976 COMMANDER 112TC	LYCOMING TO-360-C1A6D	1800	$40,000	60	1020 LBS	177 KTS	±$54,000
1777 COMMANDER 112TC-A	LYCOMING TO-360-C1A6D	1800	$40,000	60	1020 LBS	157 KTS	±$59,000
1977 COMMANDER 112B	LYCOMING IO-360-C1D6	2000	$28,000	68	1020 LBS	142 KTS	±$55,000
1977-78 COMMANDER 114	LYCOMING IO-540-T4B5D	2000	$35,000	68	1235 LBS	157 KTS	±$95,000
1979 COMMANDER 114A	LYCOMING IO-540-T4B5D	2000	$35,000	68	1235 LBS	157 KTS	±$100,000
1992-99 COMMANDER 114B	LYCOMING IO-540-T4B5	2000	$35,000	68	1235 LBS	157 KTS	±$140,000
1995-99 COMMANDER 114TC	LYCOMING TIO-540-AG1A	2000	$50,000	68	1154 LBS	177 KTS	±$170,000
2000-02 COMMANDER 115	LYCOMING IO-540-T4B5	2000	$35,000	68	1153 LBS	149 KTS	±$210,000

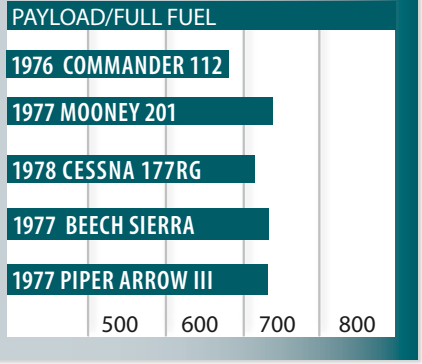
COMMANDER RESALE VALUES

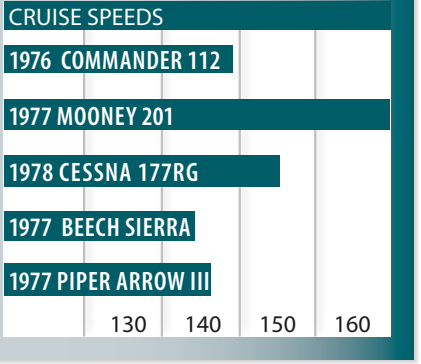


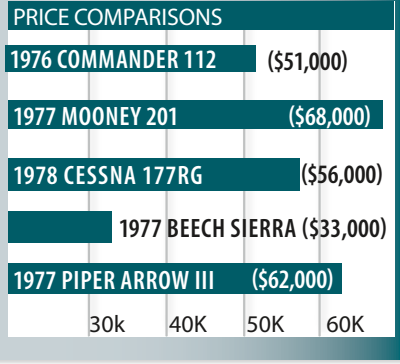
SELECT RECENT ADs

AD 2002-12-07	REPLACE OIL FILTER CONVERTER PLATE GASKET OR REPETITIVELY INSPECT
AD 2003-14-03	REPLACE OR REPETITIVELY INSPECT CERTAIN ROTARY FUEL PUMPS
AD 2006-20-09	REPLACE ENGINE CRANKSHAFT AT OVERHAUL OR AFTER 12 YEARS
AD 2008-14-07	REPETITIVELY INSPECT EXTERNALLY MOUNTED FUEL INJECTOR LINES

SELECT LATE-MODEL COMPARISONS







A Commander has enough panel real estate for modern avionics upgrades. The 114 panel at the top sports a stack of Garmin radios, S-TEC autopilot, electronic engine monitor and a Sandia electronic AI. The one at the bottom is in David Dickerson's Commander 114B. It has BendixKing Silver Crown avionics.

wingtip extensions, which allowed raising the gross to 2800 pounds for a respectable useful load of 1020 pounds. By this time the price had climbed to the $50,000 range, which was comparable to the Piper Arrow III.

The B model actually rode on the coattails of the turbocharged 112TC model, which came out a year earlier with the longer wing. A TC-A model brought with it little more than another 37 pounds of soundproofing. All 112TC models were powered by a 210-HP Lycoming TO-360-C1A6D.

As is so often the case with a new aircraft, continuing improvements and a larger engine resulted in a new model, the 114, which arrived in 1976. Powered by a 260-HP IO-540-T4A5D Lycoming engine (an IO-540-T4B5D for 1977 and later models), it was often characterized as the airplane the 112 should have been in the first place. Base price was about $47,000, and around $63,000 when decked out with options.

Only minor changes were made in the all-too-brief four-year production run of the 114. In 1977, aerodynamic improvements gave slightly improved performance. Also, soundproofing was added and fixes were made for earlier compass interference and trim-tab freeze-up problems. In mid-1977, Rockwell improved the door locks and handles, replacing the earlier flipper-style handle to a pull-out/push-up style. Also incorporated were main gear inner door mods, which filled a small, drag-creating gap. The additional attention to gear-up drag improved cruise speed by a handful of knots.

In 1979, the final year of Rockwell production, the 114A Gran Turismo model was offered. It featured a three-blade prop, new cowl flaps and an upscale interior; its average equipped price was close to $100,000.

COMMANDER 2.0

Rockwell's production of the Commander singles stopped in 1979, but it wasn't until 1988 that the company got out of the GA business altogether, eventually selling Commander rights to Gulfstream, which never produced any of the models. The Commander line soon was reconstituted by a company bearing the nameplate's original name and funded by interests in Kuwait. Headed by Randall Greene, the company purchased a facility in Bethany, Oklahoma, to maintain and repair the existing fleet, and worked toward bringing to market a new model, the Commander 114B.

In 1992, Commander certified the 114B, which included a 28-volt electrical system (instead of the original 14-volt), plus several speed mods making it faster than the original 114, including a newly designed, aerodynamically cleaner cowling. The net result was a cruise-performance improvement of 8-10 knots. Most notable among the changes are a standard-equipment three-blade prop. Base price of the first 114Bs was $169,500 (average $215,000, equipped). A turbocharged version, the 114TC (powered by a Lycoming TIO-540-AG1A), was added in 1995, with an average equipped price of $417,000.

In 2000, Commander upgraded the model again with improvements

including a lowered instrument panel, improved seats, an upgraded electrical system and TKS de-icing. These aircraft are designated the 115 and 115TC, respectively.

The later Commanders had modern Garmin avionics (GNS530/430 combinations) and BendixKing's KFC225 digital autopilot, which proved to be a good match for the airplane's performance—when the system was working—based on our experience with more than one model 115. Our advice is to pay particular attention to the autopilot's performance when considering one of these later-model Commanders. Earlier ones might be equipped with Century autopilots and many were retrofitted with S-TEC systems.

Production ceased in 2002 at the Bethany plant and the company eventually went into bankruptcy. In 2005, 50 Commander single owners banded together, formed the Commander Premier Aircraft Corporation (CPAC) and purchased the assets from bankruptcy.

After moving jigs and other equipment to Cape Girardeau, Missouri, CPAC set about to produce spare parts for the fleet, but no new airframes. In mid-2009, CPAC announced it had approved a letter of intent to sell itself to Montreal, Canada-based Aero-Base Inc. At this point, there are no new production Commanders.

In all, some 759 Model 112s of all variants were made by Rockwell, along with about 500 114s. In the 1990s, Commander manufactured approximately 127 114B models, plus 27 114TCs, while production of the 115 and 115TC hovered at around 15 or so each. Adding all that together, we come up with around 1450 copies of the various Commander singles produced to date.

PERFORMANCE

Blazing speed has never been a selling point for any Commander single. At 130 knots or so, the original 112 can barely get out of its own way; a fixed-gear Piper Archer with 20 less horsepower usually can stay even. A Beech Sierra, renowned for its casual cross-country pace, can eke out another five knots or so more than a 112. The 114, meanwhile, offers what might be called a gentlemanly cruise of about 150 knots.

A Commander gets high marks for cabin comfort, with generous legroom and decent ergonomics. That's a newer leather interior in the 114 shown here.

Climb performance and range of the 114 are both adequate. Listed rate of climb is just over 1000 FPM for the 1976 model and 1160 FPM for later ones, comparable to the Mooney 201 and Cessna Skylane RG. The 68-gallon fuel supply is enough for four hours or so at high cruise, but the 114 lacks the reserves of the Mooney and Skylane RG, both of which carry more fuel and burn less of it.

True to its government-contracting and military experience, Rockwell built into the Commander line "big airplane" touches when it comes to systems. The gear system, for example, is massively built, using a retraction/extension system similar to the Piper Arrow and based on an electrically driven hydraulic pump. Although pilots rave about the trailing-link design and its ability to soften otherwise firm arrivals, there has been a relatively high proportion of gear-collapses accidents in the past, so it may not be quite as good at sopping up thuds as conventional wisdom suggests.

Early gear collapse incidents typically involved the nosegear and, according to users experienced with the type, eventually were thought to result from distortion of a thin-wall tubing pivot pin used in the nosegear trunnion/drag brace assembly. The distortion, it is speculated, results from hard or nosewheel-first landings. In subsequent models, this part was changed to a solid pin and collapse incidents ceased. The newer-style pin can be retrofitted to any model without need for an STC and has been installed in many of the earlier 112s and 114s.

Meanwhile, ventilation, electrical

ROCKWELL 112/114 WRECKS: ENGINES

During our review of the 100 most recent Rockwell 112/114 series accidents, we were struck by two things: the relatively few runway loss of control (RLOC) mishaps and the high number accidents due to poor or lack of maintenance.

We credit good overall design for the fact that there were only nine RLOC events—evidence that the marque's reputation for good handling is deserved. We think further support for the rep is shown by the low number of stall crashes—three.

We hypothesize that more than a few pilots bought the complex Rockwell singles because of the low purchase price then discovered that a complex airplane is expensive to maintain and scrimped on maintenance. Two fires due to failure to do routine inspections of the exhaust system on turbocharged models got our undivided attention as did three crashes in which the fuel lines were so full of crud that fuel couldn't get to the engine.

One owner decided that having had two prop strikes didn't warrant checking out the engine or propeller. The reward for his diligence was a prop hub that failed in flight due to propagation of a fatigue crack initiated by one of the prop strikes.

Poor or nonexistent maintenance on airframe components such as the landing gear caused seven accidents, including two in which the nosegear steering system failed and the aircraft ran off the runway. One owner declined to repair his leaking fuel system despite warnings from other pilots. The leaks grew so extensive that, to our surprise, the airplane didn't catch on fire, it just lost so much fuel on one flight that only air was available to the engine.

We rarely see anything new when we review accident reports; however, we were struck by the owner who decided to design, build and install a "lower drag" exhaust system for his airplane. It lasted six hours before the collector cracked, hot gases opened up a fuel line and started a fire.

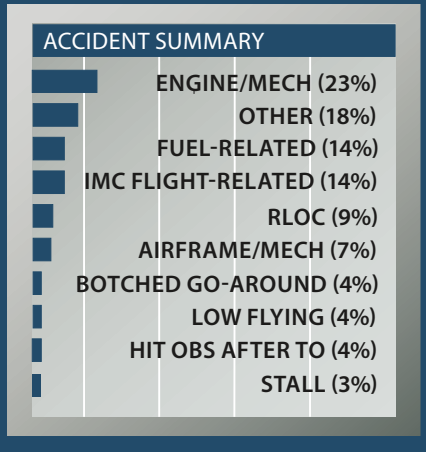
Nothing in the accident record of the Rockwell 112 and 114 raised any flags concerning design of the line. The number of fuel-related accidents was higher than we expected to see; however, only two involved failing to select a tank with fuel in it—a problem with systems that give pilots tank selection options beyond on and off. The remainder involved pilots running completely out of fuel or failing to remove contaminants before takeoff.

We do not consider a 112 or 114 as a backcountry or short-field machine, so respect for takeoff performance numbers as well as density altitude is warranted. That was confirmed by four pilots who hit obstructions after takeoff and two crashes in the mountains where the pilots flew into rising terrain.

Eight pilots pushed on trying to fly VFR into IMC and crashed. Three went well below approach minimums and hit terrain. One, instrument-rated, lost control not long after he entered the clouds on an instrument flight plan.

An owner who requested a GPU start had the aircraft's battery explode when he turned on the master switch. The GPU was putting 28 volts into a 14-volt system.

Finally, we felt the terror and shock of the Rockwell pilot who was idling on a narrow taxiway when a P-51 ran into his airplane and chopped off the tail.



and fuel systems are well thought out, in our view. Some later models are equipped with air conditioning and 130-amp alternators, providing more than enough juice to run a well-equipped cockpit.

The fuel system is unique among low-wing aircraft for having a both-tanks-selected option. One problem with the system, however, can crop up when the airplane is parked on an uneven surface and "Both" is selected: Fuel can fill the lower tank, causing it to overflow. Switch to "Off" to prevent this problem.

The engine compartment suits the overall size of the airplane and the engine's rear-mounted accessory case is readily accessible to fix what breaks. Getting to that point, however, requires removing the single-piece top cowling half. Doing so isn't an extreme burden, but is one more thing to plan for when doing much more than checking the oil.

Owners give the cabin high grades for roominess and volume, if not payload: The 112s generally have 30 to 150 pounds less useful load than other 200-HP retractables, although the margin diminishes with the A and B models. Part of this is due to the high-parts-count build; there's a lot of stuff in the Commander airframe.

And, while the 114's loading picture is much better, there's no free lunch: The 114 comes with a zero-fuel weight (ZFW) limit of 2852 pounds for normal-category operations, 2500 for the utility category. With a typical empty weight of 1905 pounds, according to the *Aircraft Bluebook*, this limits cabin payload to around 950 pounds for everyday flying. Other models certificated subsequent to the 114 also have a zero-fuel weight in their paperwork: The 112TC, 112B, 112TCA and 114B include the limitation, with the exact value determined by CG location. By the time the 114TC came along, the ZFW was set at 3000 pounds, 305 less than max gross, regardless of CG.

INSPECTION REQUIRED

By the mid-1980s, not long after Rockwell production ceased, structural problems began cropping up in the fleet: Wing spars were cracking due to stress caused by gear retraction. Two lengthy service bulletins (Gulfstream Aerospace Service Bul-

That's Rick Crepas' 1978 Rockwell Commander 114 in the photo. He chose it over a Bonanza and a Mooney for its cabin size and likes it better than his T-34 Mentor.

letin Nos. SB-112-71C or SB-114-22C, depending on aircraft model) were issued by Gulfstream, by then the marque's owner, calling for inspection and repair if needed. There were other mods to brace the spar if it wasn't cracked. All of this was given the force of law by AD 87-14-03.

The wings weren't the only problem. The tail's vertical spar attachment was cracking, too. A fix—for $2500—was mandated by AD 88-05-06. Then there were the seats. The history of this problem goes back to the mid-1970s and AD 77-16-09, requiring strengthening of the front seat framework and seat belt attachment. Then in 1985, another AD (85-3-4, now in Revision 2) came out following a couple of accidents in which front seat rollers failed and the seats came loose. This involved aircraft in compliance with the earlier AD. The new AD ordered modification of the front seat base and relocation of the shoulder strap anchor to the cabin roof between the front and rear seats.

As one result of these ADs, the Commander Owners Association (COA) was formed. The issue was not only the efficacy of the wing modifications, but who was going to pay for them and the tail mods. By spring 1989, after almost three years of legal pressure from COA, Gulfstream Aerospace and Rockwell International agreed to a settlement on the repair and upgrading of all Commander 112/114s in the U.S. and overseas. Announcing the settlement, COA President David Kaplan, and attorneys Stanley H. Rozanski and Steven R. Levy, noted it was valued in excess of $12 million.

A final airworthiness directive (90-4-7, which superseded AD 87-14-03 and also is the most recent type-specific AD) incorporated the revised procedures described in the third version of the service bulletins. That AD called for repetitive inspections until the modifications called out in the wing-spar service bulletins were completed. Actual work on the mods has been performed by the new Commander Aircraft Co., and newer 114Bs and 115s had them incorporated at the factory.

For those paying attention in the 1970s, the irony of all this is how Rockwell's original marketing efforts highlighted the 112/114's strength. Having said that, the Commander line is, nonetheless, a robust if complex airplane whose build method has more in common with military aircraft than with a modern Cirrus, as an example. And the good news is that since the wing spar AD was released in 1990, the Commander line has had only one additional AD, an inconsequential bulletin for the 114TC requiring replacement of an exhaust clamp. There are no ADs on the 114B and subsequent models. Finally, the Commander wing underwent fatigue testing, with proven good results.

MAINTENANCE

Other than compliance with the ADs, the good news is maintaining a Commander single isn't anything out of the ordinary. Still, potential

The Commander's beefy trailing-link landing gear might soften firm landings, but thorough inspection is a must. Gear collapses aren't uncommon to some Commanders.

buyers would do well to check over the paperwork to verify the logs reflect compliance. Owners and shops familiar with the rest of the fleet tell us there are very few aircraft without the mods, but they likely do exist. Do your homework before buying any Commander, which is true of any used aircraft, of course.

The 200-HP Lycoming engine on the 112 Commanders is generally considered a reliable player these days, as is the 260-HP version on the 114. But the turbocharged model had reports of broken or cracked turbine housings and the aforementioned exhaust clamp problem.

In addition to the airframe ADs originating in the mid-1980s, an individual example of a 112/114 might be subject to an AD on Hartzell prop hubs: Some two-blade props installed on early models may need regular inspections. Meanwhile, the very few airplanes on which the wing and tail AD-required mods have not been performed need an inspection every 100 hours, or until terminating modifications are made. There's also a fuel line inspection AD applicable to nearly all fuel-injected Lycoming engines regardless of aircraft model.

Other problem areas reported by owners include nosewheel shimmy, corroding flap attach brackets and aileron hinge cracks. All in all, once the SBs and ADs are resolved, there's nothing special about maintaining a 112/114 when compared to other piston airplanes of similar vintage.

Good news includes field support: Parts availability is, reportedly, no problem at all. We're also hearing from owners that overall, their airplanes are easy to maintain and upgrade.

Finally, a recent FAA Special Airworthiness Information Bulletin (SAIB) calls owners' attention to the possibility a Commander's flap switch may be operating or installed improperly. The normal switch's operation is relatively common across different manufacturers and is spring-loaded in the extension position. To retract the flaps, the switch features an over-center position. There's also a neutral, or power-off, position in between. According to the FAA, a fatal Commander accident investigation found a model 112 with its flaps fully extended shortly after takeoff. The FAA cautions pilots to verify the flap switch's operation on the ground as part of the preflight procedures. We think exercising the flaps stop-to-stop is a good idea during preflight on any airplane.

AFTERMARKET MODS

Despite a relatively small population in the field, there's a long list of STCs available for the Commander 112/114 series. A good source for research is Commander Owners Group, or COG (www.commander.org). COG's website has good information on buying and operating these aircraft, plus a forum. Cost is $75 a year. Another resource is CPAC, which also maintains a website at www.commanderair.com, and has secured FAA parts manufacturing authority (PMA) for a number of components. Most mods offer minor improvements or replacements of existing parts.

There are engine mods, too. One is the Hot Shot turbonormalizing system offered by RCM Normalizing (www.rcmnormalizing.com, 805-215-2982). The company also has spring door kits, a sturdy landing light mounting kit, plus a flap gap and aileron seal kit, which is advertised to boost cruise speed by 3 knots or more and offer better climb and tighter slow-speed handling.

Want to make your Commander a hot rod? Vermont-based Aerodyme (www.aerodyme.com, 802-264-6400) has two STCs for engine upgrades on both 112s and 114s. The 580 Super Commander upgrade was born when company founder Jim Richards wanted more speed from his own model 114. With help from Lycoming, the 320-HP IO-580-B1A STC made that happen. With a Hartzell 78-inch three-blade scimitar prop, a new ram air induction system and dual exhaust, Aerodyme advertises 185-knot cruise speeds (175 true), 2500 FPM sea-level climbs and 1200-foot takeoff performance. Once it's off, a Super Commander has a 21-percent climb gradient that can hustle to 12,000 feet in 12 minutes,

The 580 Super Commander mod from Aerodyme includes a 320-HP Lycoming IO-580 and a Hartzell scimitar prop. Expect cruise speeds near 180 knots down low.

says Aerodyme. The mod is available for 114/A/B, 114TC and 115-model Commanders. *Aircraft Bluebook* suggests adding $80,000 to the average retail price of a used Commander.

Aerodyme also has an STC to retrofit the 210-HP Lycoming IO-390 into Commander 112s. This package includes a similar intake and exhaust change and the 74-inch prop. The net gain is about 25 HP worth of performance, about 1200 FPM climb at sea level and cruise in the high 130s at 12 GPH.

The FAA repair station also does avionics upgrades, engine monitor installations, rebuilds instrument panels, plus supplies service parts and offers airframe inspections.

It currently lists an annual inspection for $2195, and $1500 when done in conjunction with one of Aerodyme's STCs. There's also a $250 landing gear actuator refurbishment service.

OWNER FEEDBACK

I purchased my 1978 Rockwell Commander 114 approximately six months ago and have flown it 105 hours so far.

I was looking to purchase a true four-place airplane that would be a good IFR platform. I was looking at Mooneys, Bonanzas and Commanders. Ultimately, the Commander met and exceeded my requirements. What tipped the scale was the roomy cockpit, two doors and that it can handle four adults with no weight and balance issues. The two-door design was very important to me because I fly with my family and I wanted two ways out if anything goes wrong.

The airplane attracts a lot of attention everywhere I go. A ramp comment I've heard more than once: "Now that is what an airplane should look like." The large spinner, great lines and the mid-tail give it a presence on the ramp that is hard to beat.

As an IFR platform it is perfect, in my view, because it's stable, predictable and inspires confidence. Now that I have made multiple long-distance trips, I am absolutely in love with this airplane. It is extremely well built, looks great, has a comfortable cabin, is fuel efficient and generally affordable to purchase and own.

The Commander may not be as fast as some other four-place aircraft, but I would rather show up little later and fresh, than be quicker and fatigued. The first long trip I took with my wife along was to South Carolina from Michigan, which took just over three hours. My wife got out of the plane and commented that she felt great, and couldn't believe we were already there. She has back issues, so that statement meant a lot. It's been her experience on multiple trips.

I have owned several aircraft, including my current 1957 Beech T-34 Mentor, along with the Commander and the Commander is my favorite.

Rick Crepas
via email

The Aviation Consumer

SpotX satcomm

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tant factor in reducing the size of the search area. From an SAR point of view, 2.5-minute tracking resolution can help reduce the search area. With GPS-derived latitude/longitude included in the tracking messages and SOS message, the search area can be narrowed. Pinpointing the device's last known location will be based upon the specifics of the terrain, for example in an open field versus under a forest's canopy.

The SOS message may be customized from your online internet account and will be sent to the IERCC. There's also a service for non-life-threatening situations, and Spot has partnered with the NSD Motor Club for 24/7 vehicle/motorcycle services. It's available in the U.S. and Canada and is $30 per year. Working alongside the SpotX device is the Spot app for iOS and Android smartphones and tablets. The app displays georeferenced breadcrumbs superimposed onto a Google map. The app allows filtering to display your breadcrumb track of a specific flight and I found it to be a handy application for others to see your flights.

CONCLUSION

So far I've used the SpotX for more than 30 hours and find the website, updater application and the SpotX device itself easy to use. The hardware is robust and the display is easy to read in direct sunlight, while sending and receiving messages in the airplane is simple—click, type and send.

Basic monthly subscription fees start at $11.95 with a 12-month commitment and allow for 20 total messages. Unlimited messages with no commitment (Flex) is $39.95. Visit www.findmespot.com for a complete fee structure.

Satcomm fees aren't cheap, but like the SpotX, could be worth it for those needing ubiquitous access to texts, email and SOS whether on the ground or at high altitudes, maintaining the cyber umbilical cord.

Contributor Phil Lightstone is a long-time IT and telecommunications professional and aviation author.

uAvionix

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unwanted attention from incumbents," uAvionix said. The company said it won't be able to comment on the proceedings, which will take some time to resolve.

Garmin doesn't comment on any ongoing litigation, although the litigation document states that it sells the GDL82, GDL84 and GDL88 ADS-B systems to Garmin OEMs and dealers, and it "competes directly with uAvionix." The document also says uAvionix approached Garmin with "promises of new technology in the drone market and Garmin engaged in extensive communications and meetings with uAvionix throughout 2016 and 2017," and realized that uAvionix had not developed any new technology. It goes on to say Garmin made efforts to resolve the infringement on the 301 Patent before resorting to litigation.

The document reitorates that the uAvionix EchoUAT and skyBeacon products "are not merely for amusement, to satisfy idle curiosity or for strictly philosophical inquiry, but instead have a definite, cognizable and not insubstantial commercial purpose." Yes, the uAvionics ADS-B products directly compete with Garmin's low-cost (under $2000) ADS-B Out solutions.

Some buyers are understandably concerned about investing in any uAvionix product given this lawsuit. The company said publically that "this suit in no way impacts our ability to certify and ship any of our products—including the skyBeacon and tailBeacon. We are innovators with integrity and are defending that integrity."

With the ADS-B equipage mandate nearly 15 months away, we'll be following and reporting on this litigation in future ADS-B coverage.

FEEDBACK WANTED

COLUMBIA 300/350

We're preparing a report on the Columbia/Cessna 300/350 piston single market in an upcoming Used Aircraft Guide in *Aviation Consumer*. We want to know what it's like to own these 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 **(full-size, high-resolution please)** you'd like to share to the email below. We welcome information on mods, operating expenses or any other comments that can be helpful for buyers considering one. Send correspondence by November 15, 2018, to:

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