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The Aviation Consumer®

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BASICMED: HIGH-ALTITUDE OPS KILLER

With nose bag in place and arms crossed at FL210 picking off the miles like nobody's business on a Cirrus demo, I got to thinking about the FAA's new BasicMed. Particularly, how pilots might be tempted to bend one of the rules to squeeze the most efficiency from a turbocharged airplane.

The FAA's advisory circular AC 68-1, which describes how pilots can exercise their certificate privileges without holding at least a Third-Class medical certificate, limits flight above 18,000 feet MSL. Tempted to crack FL180 for another 6 knots in your turbocharged Mooney? According to the advisory circular, you'd be operating outside of BasicMed privileges. There's even a bit on flight planning.

Got no choice but to climb into the flight levels to avoid a thunderstorm or icing? The rule makers expect BasicMed pilots to stay on the ground if there's a possibility that weather will influence altitude-busting decision making. In parts of the country where ice and thunderstorms are a way of life, that could mean a lot of cancelled trips.

AC 68-1 specifically says, in part, that the aircraft must operate at or below 18,000 feet MSL during the entire flight. It goes on to say for BasicMed pilots operating aircraft capable of flight above 18,000 feet MSL, the pilot's preflight planning must accommodate the altitude limitation. "For instance, if weather phenomena like icing or thunderstorms are forecast (or is within reasonable possibility) within the pilot's route of flight that would necessitate climbing above 18,000 feet MSL, the FAA considers initiating such a flight to be contrary to BasicMed," it says. In other words, keep the airplane in the hangar. A bit draconian, or should the FAA be worried that BasicMed pilots will fall out of the flight levels because they haven't passed a Third-Class exam?

That's what the exam is for, but more than one AME told me they wouldn't examine a BasicMed patient any differently than they would for one applying for an airman medical certificate via the current FAA form 8500-8 application. Specifically when it comes to the high-altitude restriction, it would appear there is little clinical argument to keep properly examined BasicMed pilots from the flight levels. "I don't know what's different about having a heart attack at 17,999 feet than at 18,000 feet," one said. When he questioned this part of the advisory circular, another AME was told the agency isn't commenting on these specifics until BasicMed kicks off on May 1 of this year. Maybe it will be tweaked. Every AME I spoke with agreed that some of BasicMed's restrictions seem arbitrary (another might be BasicMed's 250-knot speed restriction), perhaps to differentiate it from Third-Class medical privileges.

I get that BasicMed (remember, AC 68-1, like any advisory circular, isn't an FAR—it's advisory) is a compromise and I'm grateful for another option for medical certification. It's just that after dealing with the old system, I hoped for a more realistic clinical approach to certification. Years ago, I had surgery to cure a life-threatening disease. Responsibly, I grounded myself during my post-op recovery and reported the surgery during my next FAA medical exam. My local AME deferred my application to the regional flight surgeon, who after review of my stack of medical records quickly determined I was eligible for a Second-Class and issued me my certificate, with no other effort required, other than reporting any changes in my health. Case closed. Years later, I got a letter from the FAA's certification branch saying that my disease (which the FAA once acknowledged was cured) meets CACI criteria, but I had to provide medical reports on its status. If someone in the office was familiar with the disease—and the well-documented, previously approved surgery that cured me—they would know there is no clinical basis to this request. Maybe if the FAA considers the number of small turbocharged pistons in the fleet, it will lift that silly altitude rule.—*Larry Anglisano*

THOSE MAGICAL CLASSICS

I read the article on owning and maintaining classic and antique aircraft in the March 2017 issue of *Aviation Consumer* and can certainly relate to the challenges of keeping these old birds.

Ours wasn't quite as exotic as your examples—we had a polished 1949 Beech A35 Bonanza—but even with the benefit of continuous production, parts were occasionally a challenge.

Corrosion, however, was the biggest demon. No one envisioned these old planes lasting 70-plus years, so corrosion protection was nary a thought in anyone's mind.

As a result, I ended up replacing the belly skins and 80 percent of the lower cabin structure—from the rudder pedals to the aft cabin bulkhead—due to corrosion. Fortunately, it missed the spar carry-throughs, otherwise I would have had to scrap the airplane. As it was, it cost nearly $20,000 to bring it back to flying status, and that was 10 years ago.

We sold the airplane a few years ago after outgrowing it. While we ended up with another Bonanza (a far more modern A36), there is something magical about those old planes that doesn't exist in newer ones. Maybe that's what keeps people interested in them.

Chris Nichols
via email

Your classic and antique aircraft ownership article was perfectly timed around my purchase of a barn-found old Cessna.

After coming to my senses and calling off my search for a foreign warbird (which you didn't touch upon), your article confirmed what I suspected: Owning an old Cessna will just be easier—I hope. Thanks for all you do.

J Speilding
via email

We'll look at warbird ownership in a future issue.

FUEL GAUGES UPGRADES

Nice article on fuel gauge upkeep and replacement in your March 2017 issue. I replaced the original equipment gauges on our Bonanza a couple of years ago as part of an engine monitor upgrade. We went with the Aerospace Logic FL202. While we've had very good results using the original fuel quantity sending units, there are a couple of potential gotchas that might be worth mentioning.

First, anyone contemplating such a replacement should be prepared for additional work beyond the gauge. These units have quite precise software, so if there are any faults in the sensing circuit, it absolutely will be flagged during calibration. In our installation, one sending unit was shorting to the structure, which effectively removed the other sending unit from the circuit and prevented tank calibration beyond the halfway point. It took a lot of time and effort to first identify and then correct the fault.

Second, many (if not all) of these kinds of digital gauges use LCD displays, which require voltage to illuminate the backlighting so you can see the display. That happens to be the exact opposite design of legacy (incandescent) lighting systems. Some manufacturers accommodate this difference. Aerospace Logic, for whatever reason, didn't, so you might be faced with installing a separate dimming system, or rework the existing lighting circuits to accommodate it. In either case, this means extra planning, work and money.

But it could all be worth it. The benefits of digital replacements for analog instruments should be fairly obvious. Aside from improved accuracy and reliability, the readability and space and weight savings can increase safety and even useful load. You just need to do some homework to minimize the potential for unpleasant surprises.

Wes Miller
via email

O2 CONCENTRATORS

In the portable oxygen market scan article (January 2017 *Aviation Consumer)* you claim that most portable oxygen concentrators require a 110-volt input, but I think that might be old data at this point. The aviation-specific units are based on medical units, and those have been 12-volt friendly for a while now.

I bought the Inogen oxygen unit marketed by WindBlade here in California about four years ago. It's worked flawlessly in my turbo Cardinal. Inogen claims you can share the unit below 15,000 feet between two breathers, but I haven't had consistent success with that. The newer two-person unit is probably a better bet. Since the incremental cost is pretty close to zero, I find myself putting O2 on whenever climbing above 5000 feet and arrive sharper and less fatigued.

It's not cheap, but there's no hassle of figuring out where to find O2 on the road or waiting for a mechanic to refill my bottle.

Paul Millner
Cardinal Flyers Organization

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Cirrus SR22T G6: More Style and Avionics

With ultra-modern lighting, interior and electronics upgrades, the new Cirrus G6 models strike the right combination of luxury and performance.

by Larry Anglisano

Let's get this out of the way, shall we? Cirrus salespeople aren't apologetic that a fully loaded 2017 SR22T GTS comes with an eye-widening invoice north of $900,000 when you tack on an extended warranty. Cirrus offers less expensive models, of course, but the turbocharged SR22T is the most popular seller. Just how many buyers would spend nearly $1 million for an unpressurized piston single, you might ask? More than you might think.

AIRCRAFT FLIGHT TRIAL

While recent GAMA sales reports showed a flat market for new piston aircraft sales, Cirrus enjoyed continued sales growth—selling 317 total units in 2016—bringing the global fleet to more than 6500 SR series aircraft. It's not backing down.

In addition to delivering several Vision Jets, Cirrus began 2017 by launching the G6, its sixth-gen SR model line and as we go to press, delivery slots for the latest and greatest SR22T are booked out to August.

For this report we took the keys to N828PT, a spanking new SR22T, for a couple of days, which included a round-robin cross-country trip from our home base in New England with a stop at the evolving Cirrus Vision Center customer delivery and support campus in Knoxville, Tennessee.

PERSPECTIVE+ AVIONICS

Whether it's the entry-level SR20 (we'll look at it in a separate article) or the flagship SR22T, a sizable upgrade to the model line is Garmin's G1000 NXi next-generation integrated flight deck. Cirrus was the first OEM to adopt the new system, which it calls the Perspective+. We covered the G1000 NXi in the February 2017 issue of *Aviation Consumer* so we won't go into the architecture here. The Cirrus version has nearly all of the same functions and improvements as the version made for King Air retrofits—and then some. This includes brighter displays (standard is two 10-inch displays, but just about every buyer springs for the larger 12-inch screens), a much faster processor, a redesigned system controller that finally has a QWERTY keyboard, plus there's a stone-simple on-screen weight and balance/flight planning utility. Simply enter the weights for each seat/baggage area, and the system computes a weight and balance report, while taking into consideration fuel and de-icing fluid.

Cirrus advertises the useful load at 1248 pounds, and a cabin payload of 893 pounds with three hours of trip fuel with 45 minutes of reserve. The fully optioned aircraft we flew carried 74 pounds of de-icing fluid and topped-off oxygen (6 pounds of O2) for an available 679 pounds.

Like all G1000s of late, the Perspective+ has Garmin's GFC700 autopilot with full envelope protection, including hypoxia protection. But what is new is the optional automatic yaw damper. There's no yaw damper button on the new autopilot control panel—which is the same one that's used in the Cirrus Vision Jet. Once the aircraft breaks 200 feet AGL in the initial climb, the yaw damper engages. Pass 200 feet when landing and the yaw damper automatically disengages.

The SR22 G6 now has all-glass flight instruments; the steam-gauge backups that used to live in the lower subpanel have been replaced with the Mid-Continent SAM electronic EFIS. It's linked to the primary PFD so whenever you change the primary

CHECKLIST

- The G6 is arguably the most advanced piston single ever produced.
- Standardized systems and ergonomics are an attempt to ease Cirrus Vision Jet transitions.
- Lack of pressurization and a small cabin might be a put-off for some top-of-the-model buyers.

That's the SR22T Platinum edition in the lead photo. We found the G6's fit and finish to be outstanding, inside and out. For the price, buyers will demand it.

baro setting, it automatically changes the setting in the SAM backup. That's a big convenience.

There's an angle-of-attack system made by Safe Flight Instrument Corporation and AoA data is displayed on the Perspective+ PFD.

AUTOMOTIVE INSPIRED

The G6 is really the culmination of everything Cirrus has done to the airplane since its introduction in 2001. Later versions always had generous creature comforts, but we think the five-place leather interior of the G6 is the best yet.

For 2017, it's a bunch of thought-out small improvements that when added up just make the cabin, which has 60/40 split rear seating, a more comfortable and accommodating place to be.

For instance, you don't hang the headsets from the overhead anymore. Instead, leather snap-straps on the side of each seatback keep them out of the way when you egress and ingress the cabin. Need a place to park your smartphone? There are strategically placed pockets on the edge of the front seats (between your knees) made for it. With way too much camera gear aboard, we were ecstatic to find no fewer than four USB charging ports in the center armrest—more than some hotels.

You'll want to keep your devices charged because the G6 is big on wireless connectivity. The Garmin audio panel has Bluetooth, so you can handle phone calls through the standard Bose A20 headsets and also stream your tunes in. Optional is Garmin's Flight Stream 510, where you sync flight plans and load databases into the Perspective+, and have roaming control over the SiriusXM radio in the Garmin Pilot app. There's also the optional Cirrus Global Connect system, which uses Garmin's GSR56 Iridum satcomm system for sending and receiving SMS text messages directly from the Garmin Pilot app.

You don't need to spend much time with the G6 before you recognize that its styling and ergonomics are high-end sports sedan-like. New for 2017 is a key fob for locking and unlocking the doors. The airplane even has automotive-style environmental controls—with three-speed fan, recirculating and defroster modes—and good air conditioning and heater performance.

The 12-inch Perspective+ displays, top, are optional but we can't see settling for the standard 10-inch screens. Most every buyer doesn't. Notice the leather headset straps on the inboard sides of the seats. Round gauges are gone for good—the backups are EFIS, middle photo. The G6 has no touchscreens. The Perspective+ uses a redesigned mechanical QWERTY keypad controller for data entry.

But as comfortable as the cabin is, it's still unpressurized. For some—especially traveling families—that could be a deal breaker for an airplane in this price category. With its twin turbochargers, the airplane is really at its best in the low flight levels. Maximum operating altitude is 25,000 feet. No, BasicMed pilots can't fly it there. The SR22T has a built-in oxygen system with a command switch and quantity annunciator that's nicely located forward of the throttle quadrant.

An easy way to tell a G6 from other generation Cirri on the ramp is by the lighting. New on the G6 is the Spectra automotive-inspired wingtip LED lighting system designed exclusively for Cirrus by Whelan Engineering. The entire wingtip houses a variety of LEDs for landing lights, nav lights, position lights and an aesthetic Halo light that automatically comes on when

The new Spectra LED lighting from Whelan is nothing short of stunning, not to mention practical. The landing lights automatically switch to wig-wag mode during climbout, and back to solid during descent. Also new is a keyless entry system, which automatically turns on the convenience lights. Turbo models have a built-in 1600-PSI-capacity O2 system.

you unlock the doors with the key fob. Additional convenience lighting is scattered around the aircraft, including LEDs that illuminate the cabin steps and under-wing ground lighting, which illuminates a good chunk of ramp space around the airplane. The cabin dome light, footwell lights and baggage area lights come on when you unlock the doors.

In the air, the wing-mounted landing lights automatically switch to wig-wag mode when you climb through 300 feet AGL. In the descent back through 300 feet, they turn solid. We made a night landing and can attest they are extremely effective. Couple them with the SVT synthetic vision and optional Max Vis infrared night vision camera and you'll never sweat another night landing again.

KNOWN ICING

The airplane is certified for flight into known icing, equipped with a TKS system with wing tanks that hold four gallons each of TKS fluid. The system uses two pumps for protecting the leading edges of the wings and the vertical and horizontal stabilizer. In the Normal mode, the pump cycles on and off in 30-second intervals, which leaves a 2.5-hour endurance. In the High setting, one of the pumps runs constantly, which cuts the endurance in half. At the maximum setting, both pumps run full blast for two minutes. At that point, endurance is shaved to 30 minutes. Clearly, if you're running those pumps on maximum, you're doing everything you can to get on the ground.

The High setting can be strategically used for de-icing. For instance, you're cruising along and run into frozen clouds and immediately build ice. Run the system on high to knock the ice off, then switch back to normal to help keep the ice off. There's also fluid nozzles at the bottom of the windshield.

FLYING IT

Prepping to fly a new Cirrus starts with the new interactive flight operations manual, or iFOM. Cirrus thinks of the POH as a legal aircraft document, but the iFOM is how it trains pilots to fly the aircraft. The iFOM is a multi-touch iBook covering techniques, standards and detailed operating procedures. We found it to be engaging and useful.

As you would guess, a huge part of transitioning to the G6 is learning the Perspective+ avionics and you'll want to know it well. Eyes are on the MFD from the second you switch the two batteries on.

The SR22T is powered by a 315-HP Continental TSIO-550-K twin turbocharged six-cylinder engine. On the takeoff roll, where the big Continental spools to 36 inches of manifold pressure and 2500 RPM (with its fixed governor, there's no prop control), the drill is to apply full power and a healthy amount of right rudder. Once rolling (with 50 percent flaps deployed), pull a slight amount of back pressure to get the weight off the castering nosewheel and the airplane flies itself off. And that 80-knot rotation speed comes quickly. The ground run on a stan-

YouTube See a video review of the SR22T G6 at http://tinyurl.com/j95ht2a

dard day at gross weight is 1517 feet.

Accelerate to 90 knots, retract the flaps and pitch for Vy, which is 103 knots. We saw initial climb rates of 2000 FPM, which makes for a fairly steep deck angle for VFR climbs, especially with the large glareshield. When passing 600 feet, which is the magic altitude should you need to deploy the CAPS whole-airplane parachute, establish a cruise climb by pitching for 125 to 130 knots and you'll keep the CHTs below 400 degrees. Cruise climb is at full power and at lean of peak by simply keeping the throttle fully forward and pulling the mixture back to the blue LOP line on the fuel flow gauge.

The first leg of the long-distance trip was southwest bound into a demoralizing headwind. At 6000 feet set for a lean-of-peak cruise (30 inches MP) the fuel flow was 17.2 GPH and yielded 176 knots true airspeed. In this airplane, it's typical to flight plan for 180 knots at 10,000 feet. But you don't buy a turbcharged SR22T to fly low. Above FL180, you'll flight plan for 200 knots true.

On the northeast-bound return trip at FL210, we saw 203 knots true. From sea level to FL200, pretty much plan on a 40-minute climb at the mentioned climb power settings. With a 40-knot push on the tail and minimal level-offs in initial climb, that made for a nonstop flight from Knoxville, Tennessee, to Hartford, Connecticut, in just shy of three hours.

The SR22T's fuel capacity is 93 gallons and fuel management is a no-brainer thanks to the range/endurance utility on the MFD. The navigation page tells you everything you need to know about your current fuel status, including the exact amount of fuel that's on board and the calculated FOD, which is the fuel remaining over destination. Zoom out on the map and fuel range rings show the endurance. For instance, you can set the utility so it draws a dotted green range ring, which tells you where on the map there will be one hour of fuel remaining. A solid ring tells you where you'll run out of gas. Enrichen the mixture and you'll see those range rings shrink as the fuel flow goes up.

Anyone who runs out of fuel in this airplane deserves the Darwin award. In addition to the map and digital fuel gauges, the PFD has six

The SR22T comes with a three-blade Hartzell composite propeller, top photo, which is an option on the normally aspirated SR22. The Xi personalization program is highly customized paint and interior work. Surf's up.

different annunciators warning you of the pending trophy. An on-screen scheduler tells you when to switch tanks.

With pitch and roll trim compression springs, control pressures are moderate and you'll quickly realize that the electric trim system is your ally. While the springs give the aircraft impressive stability in turbulence and create a tendancy to return it to level flight (when the GFC700 autopilot isn't flying, of course), if you fight them by not trimming during landing you'll surely lose.

And once you figure out the correct sight picture over the large glareshield—and nail the correct speeds—you'll be rewarded with confidence-building landings. It helps that you can lower the first notch of flaps at 150 knots and start slowing down early. What worked for us was crossing the numbers at 80 knots with full flaps. Keep the nose down and resist flaring too early, otherwise it gets ugly.

CHOOSE YOUR WHIP

Cirrus offers a healthy number of option packages throughout the SR product line—far too many to list here. The partial list includes avionics add-ons (active traffic and TAWS, for example), the Carbon, Platinum and Rhodium appearance packages and other upgrades that alter price and weight. See the sidebar on page 8 for customization processes above and beyond standard packages.

The aircraft flown for this report was the flagship GTS equipped with nearly every equipment option available. It was being sold with a five-year extended warranty at $933,000. The SR22T base price is $631,900, which includes a two-year spinner to tail warranty.

A lot of dough? You bet it is. Still, Cirrus says roughly 40 percent of its buyers move up from older Cirrus models. After living with the new G6 for a couple of days, we think it could be the best one they've purchased, based on its creature comforts and improved systems.

VISION CENTER: "All THINGS TO CIRRUS OWNERS"

While Cirrus Aircraft's manufacturing operations will remain at its headquarters in Duluth, Minnesota, and also in Grand Forks, North Dakota (where composite components are produced), customer deliveries and training are now staged from its expanding Vision Center campus at the McGhee Tyson airport in Knoxville, Tennessee. As an expansion of its business—and partly to support deliveries of the now-certified Vision Jet—the Vision Center is where factory repair support, aircraft customization and customer training takes place. At press time, Cirrus has already staged close to 70 aircraft deliveries from the Knoxville location.

The campus is made up of three major components to include the Cirrus Experience Center (which temporarily accommodates customer training, among other things), the factory service center and the delivery center. Cirrus is preparing to break ground on a 20,000-square-foot training facility to house a full-motion Level D simulator for the Vision Jet, plus several fixed training devices for the piston aircraft line. The new facility will also house the company's flight ops department. The showpiece of the campus will be the actual Vision Center, which will house retail space, customer lounges, FBO services and custom design services for the entire product line of aircraft.

During my recent visit, I spent some time with Stephen Deucker, the Vision Center's vice president and general manager. The enthusiastic Deucker seems the right guy to ensure that buyers who plop all that money on the table for a new Cirrus have a high-end experience along the way. Before coming to Cirrus, he spent much of his career as an executive in the luxury hotel industry.

Cirrus rolls out the red carpet—literally—for buyers picking up their new aircraft. Before the training, familiarization or acceptance flight is accomplished, you'll walk into the hangar along a red carpet leading to the airplane. One owner told me the experience exceeded her expectations tenfold. "My SR22 is the third new aircraft (and third brand) I've purchased and the experience blew the others away," she told me.

"As we grow this campus, we're

going to be all things to a Cirrus owner; a place for Cirrus pilots to stop just to check out what we're doing," Deucker told me.

The company picked the Knoxville location for several reasons, most of which are obvious when you visit. The weather is far more favorable than Duluth and the location is more centrally located for the fleet of U.S.-based Cirrus owners and pilots. Plus, the campus is within walking distance of commercial airline service. There's also a Hilton hotel that's less than a minute's shuttle ride away. Better yet, McGhee Tyson (KTYS) is one of those underutilized airports located in Class D airspace. I flew in and out of Tyson a few times during my visit and never waited in line to take off or land.

Planning on customizing your new Cirrus via the Xi personalization program? The Vision Center is the place to do it. Here you'll consult with design experts who help plan custom paint and decal work, custom interior pieces, door sills, seat stitching and carpeting. Xi personalization isn't chump change. It adds nearly $60,000 to the price of an SR, and isn't yet available for the Vision Jet.

Not sure what you want? It really is a personalized process. Instead of looking at previous Xi projects, you'll first be contacted by someone from the Cirrus design team to better understand your goals while using the airplane. Got special interests and hobbies? Put them on the table.

"It's more about building and designing an aircraft that is a personal reflection of the owner, rather than choosing materials from a catalog and putting them together," said Cirrus senior line manager Ivy McGiver. Once a design is finalized, it is slotted into the production schedule. It doesn't usually take any longer to actually build the Xi aircraft, but Cirrus allows some extra time for extra attention to detail while the aircraft is on the line.

The Vision Center is also a place to maintain a Cirrus. The factory service center is owned and operated exclusively by Cirrus and is staffed by many techs who worked at the service center in Duluth. Next to the delivery hangar is the service hangar. Cirrus offers just about every service an owner might need. This includes oil changes, 50-hour and annual inspections and engine swaps. The service center is also equipped with a paint finishing booth for taking care of blemishes and other rash that's inevitable once the aircraft hits the field.

The way Deucker put it, "In some ways, the Vision service center in Tennessee is like taking your Mercedes to Munich to get its oil changed."

—Larry Anglisano

Garmin Flight Stream: Worth It For Some

Garmin's Flight Stream 510 Wi-Fi datacard saves big on install effort. While there's room for improvement, flight planning and nav updates are high points.

by Frank Bowlin

While wireless connectivity is taken for granted outside the cockpit, it's recently begun to see some use in the cockpit. Portable ADS-B devices connect wirelessly to our portables, but wireless communications with panel-mount, certified avionics is far less common. Garmin changed that with its RS-232-based Flight Stream 100/200 wireless hubs.

The Flight Stream 510 takes connectivity to a higher level because installation is as easy as popping an MMC datacard in the slot of the GTN navigator. We've been using the interface for some time and recognize some benefits that could be worth the $1500 buy in. Here's a report.

LIMITED MARKET

Aspen Avionics was the first to offer wireless connections between the panel and a tablet. Its Connected Panel technology uses the Evolution PFD and MFD as a gateway between the navigator and an iOS tablet running the popular ForeFlight navigation app.

Not far behind, Garmin introduced its Flight Stream products hosting communications it calls Connext. (Flight Stream is the hardware; Connext is the feature set.) Other manufacturers have point solutions, but everybody has thus far shared the need to physically install one or more wired boxes in the airplane to provide that wireless capability. That might be easy if the aircraft is opened up for install, but maybe not so much if it needs to be torn apart for a second installation.

Garmin's $1495 Flight Stream 510 for the GTN-series navigators (it won't work with the discontinued GNS navigators, but the wired Flight Stream 100/200 will) extends the Connext concept. The FS 510 is a multimedia card—think SD card—that houses 32 GB of memory plus Wi-Fi and Bluetooth transceivers.

Although the FS 510 is technically a dealer-installed item, installation amounts to simply popping the SD database card out of your GTN navigator, replacing it with the FS 510 and pushing a few buttons for configuration. We got hung up on the configuration step for two reasons. First, we installed it ourselves. Second, the required configuration is in the separately downloaded documentation, but you have to go looking for it. We were in too big a hurry to try out the new toy and overlooked the requisite instructions. As a reward for our oversight, we got to spend time on the phone evaluating the quality of Garmin's tech support group, who patiently explained what we needed to do.

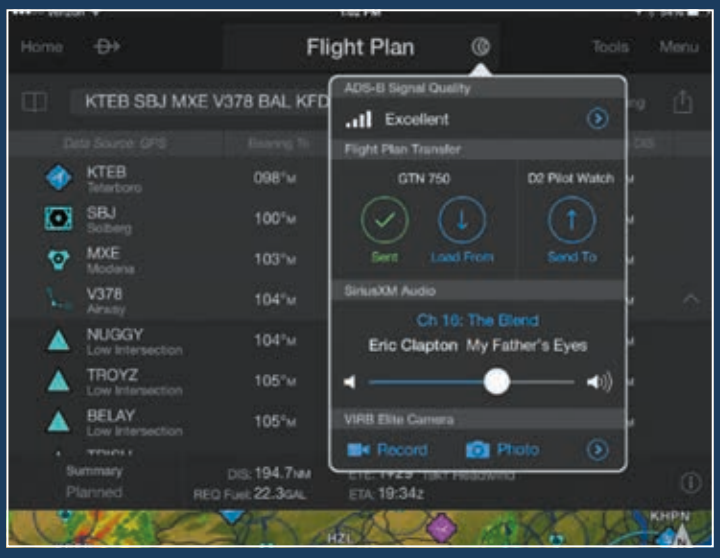
This is all there is to it: Replace the GTN's existing SD database card with the FS 510 and configure the box(es) for it. Total installation time

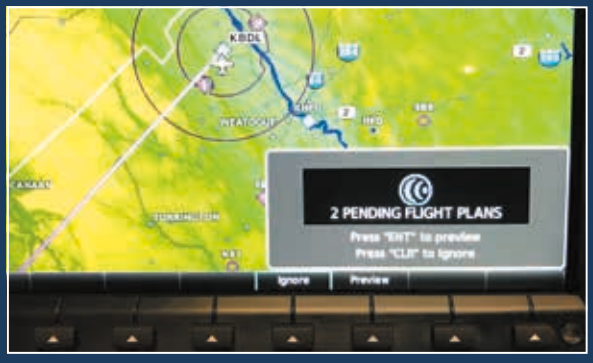
No wiring required. The $1495 Flight Stream 510 multimedia card shown below houses 32 GB of memory, plus Bluetooth and Wi-Fi transceivers for connecting iOS and Android tablets to select Garmin panel avionics.

CHECKLIST

- ⊕ Two-way data streaming offers more flexibility for playing traffic and weather on a tablet.
- ⊕ Flight Stream curtails the process of loading flight plans and nav databases.
- ~ We hoped for a redundant EFIS display with the FS 510/G500 interface, but it doesn't exist.

GARMIN CONNEXT AT A GLANCE





Clockwise from upper left: The wireless flight plan transfer to and from Garmin Pilot is accomplished in the app's flight plan utility. While not a function of Flight Stream, notice that you can also send data to Garmin's D2 pilot watch. Users might find it more convenient to view weather (ADS-B and SXM satellite) on a tablet than on panel-mount devices. The data is the same, coming from the same sources, but app navigation and presentation might be better than it is on the smaller GTN650. Flight Stream is embedded in the new G1000 Nxi.

should be under five minutes if you know what you're doing—10 minutes if you're reading the directions for the first time.

For this effort you get the same capabilities via Bluetooth offered by the Flight Stream 210 hard-wired black box, plus a Wi-Fi connection for a feature of Connext Garmin calls Database Concierge.

Connext features are available with Garmin Pilot on Apple and Android devices and with ForeFlight on Apple. However, not all features are available on all combinations as we'll note. Also, those Connext features require Flight Stream hardware, but some are built in to Garmin's GTX 345 ADS-B transponder, which has integral wireless Bluetooth capability.

WIRELESS DATA

The Wi-Fi connection in the FS 510 is there solely to support Database Concierge, available only on the Garmin Pilot app. Database Concierge allows wireless database updates to the GTN navigator(s), the G500/600 PFD/MFD or the new G1000 NXi just announced. Neither the legacy GNS530/430 (or GNS-WAAS) navigators or currently installed G1000s are compatible with Database Concierge.

Using this feature is easy, but not necessarily obvious the first time you try, based on our trials. Assuming you've previously subscribed to the appropriate data, your copy of Garmin Pilot will download the databases required by your avionics suite. Then, on initial power up of the navigator, and before you "Press to Continue" past the database-status page (another important step we initially missed), the Wi-Fi in the FS 510 is enabled. You connect Wi-Fi in your tablet to the FS 510 and after a short time to figure out what needs to happen, the data is transferred from the tablet over the Wi-Fi to the FS 510 with a couple button-presses to get it started.

Your effort to update the data is a bit less than even writing an SD card at home. You can configure Garmin Pilot to automatically download the database updates for your aircraft, so that part is hands off. When you get to the aircraft, perhaps while doing your preflight inspection, power up the GTN navigator and push a couple buttons to allow the data to wirelessly flow from your tablet to the navigator.

A full database transfer including Garmin's FliteCharts took a bit over 10 minutes, so this step is suitably quick. What happens from there depends on the rest of your equipment.

Say you've got two GTN navigators and a G500. Just like the two navigators can sync flight plans between

them, they can now also sync the single database you just uploaded. Plus, if your G500 is also configured for database sync—again, a quick setup—the data will also start streaming to your EFIS at the same time. But, none of that happens as quickly.

We were able to sync all the data from the FS 510 to the G500, excluding FliteCharts, in about 10 minutes. Transferring the massive FliteCharts database to the G500 took over an hour. Obviously, that's too long for a preflight, and longer than most of us would want to leave the aircraft battery on without external power. Plus, after a database update to the G500, you have to reboot it for the data to take effect. Clearly, you'll not want to do that in flight. All of these factors conspire to make updating FliteCharts in the EFIS via the FS 510 a bit impractical. But, there's a workaround.

Update the other databases as you normally would, but don't wait for the FliteCharts update to complete. Instead, shut everything down for your engine start and then go flying. Thus, the G500 is rebooted to accept the data you did just update, not including FliteCharts. While you're flying, the FliteCharts database will continue to transfer from the FS 510 to the G500.

Knowing the time that takes, Garmin added a clever feature. If you need to display a chart, the current version is explicitly brought over from the FS 510. In this way you don't have to wait for the FliteCharts update to complete; you'll get current charts anyway. Unless you're just going round the patch, FliteCharts will usually be updated in the G500 by the time you land, so your next flight will also allow the G500 to reboot as necessary for the FliteCharts update to "take."

In fact, despite all the wireless capabilities being promoted for Connext and Database Concierge, you will still need to separately and directly load the terrain database to the datacard in your G500/600, if you have one. As it turns out, that one database is massive—simply too massive to send it across the comparatively slow data connection between the GTN and the G500/600. (Remember, the FliteCharts database takes on the order of an hour to make the trip. The terrain database is bigger.).

Fortunately, the terrain database is updated infrequently, so you can still use the Database Concierge for all other updates. But, you will still need to remove the datacard from the G500/600 and download the terrain data directly to it via your computer. Most of us previously took the datacard home from the airplane and updated it, hopefully remembering to take it along on the next trip to the airport. It is possible, and relatively easy with just one database, to independently download the database at home from your high-speed internet connection, then simply write that update to the card the next time you're at the airplane. No internet connection required and no taking the datacard home.

The $995 AHARS-equipped wired Flight Stream 210 Bluetooth hub (top) is still in Garmin's lineup and enables flight plan transfer, but not Database Concierge, to and from the GNS530W/430W navigators. Chart updates to the G500, bottom, are slow.

BONUS: CHEAPER DATA

A few months back, Garmin announced OnePak database packaging. This Garmin-sourced data is offered at a savings over the PilotPak we'd previously used. The packaging and bundling is somewhat different, so savings vary from slight to significant. We saw a bit over a 20 percent reduction in our total database pricing.

But there's also a bonus. If you're using Garmin Pilot, a OnePak subscription includes the $75 IFR upgrade. (You still pay for the basic VFR Garmin Pilot.) You can take advantage of OnePak pricing without a FS 510—it is even offered for GNS navigators—but to use Database Concierge, your data must come from a OnePak subscription.

FLYING IT

Once you've updated your data and gone past the Press to Continue prompt, the Wi-Fi in the FS 510 turns off and Bluetooth turns on. All the inflight capabilities of Connext communicate with your tablet via Bluetooth. And, while mostly unchanged from the FS 210, those capabilities are significant. If you have the requisite capability in your panel, Connext allows the streaming of various information from the certified panel-mount devices

ForeFlight Mobile app users can use many of the Flight Stream functions, but not the Database Concierge. Flight plan transfer is accomplished using the "send to Garmin" command, top photo. While the GTX 345 wireless transponder, bottom, can stream traffic and weather to the tablet, it won't handle flight plan transfers or database updates.

through the Flight Stream device to your tablet.

Perhaps the most obvious and useful feature is the ability to transfer flight plans between your tablet and your navigator. Most of us do our flight planning at home. Using Pilot or ForeFlight, of course, you can brief and file that flight plan. But previously, when you got to the airplane, you'd still have to enter it into your navigator, a step that could be tedious.

Now, you can just enter a command on your tablet and the flight plan is sent to the navigator. From there, you accept and load it and you're good to go. Once underway, any inflight changes you make similarly propagate back to the tablet where you're asked if you want to accept them. Note that flight plan transfer requires an actual Flight Stream device; it's not available from the Connext capabilities of the GTX 345 ADS-B transponder.

Via Flight Stream, GPS position data from the panel navigator is sent to the tablet. While you might have a tablet with built-in GPS, the panel-mount position information is far more precise and reliable, plus it will match what you see on the panel.

Traffic via TIS-B (ADS-B In), if available in your panel, is also sent to the tablet. While this might seem redundant, it's particularly useful if you have a helper in the right seat who can't necessarily see the display. The aircraft we used to evaluate the FS 510 does not have TIS-B, but it does have active traffic in the form of Garmin's GTS 820. Unfortunately, that traffic is not available on the tablet. (But we can hope.)

Weather data you get in your panel is sent to your tablet. The source can be FIS-B (ADS-B In), or if you're using Garmin Pilot, Sirius XM weather and entertainment via the GDL69A receiver; they both work essentially the same. We see a few advantages to viewing weather on the tablet. Sometimes it can be a button-pushing challenge to get the weather you want from the panel-mount devices. Operating your tablet can be a lot easier.

Also, you simply might prefer to have something other than a weather page showing on the panel display, especially on space-challenged screens like the smaller GTN650. Plus, you might be busy with flight duties, but want to check the developing weather at your destination. Asking your right-seater to pull it up is much more efficient and safer than diverting a lot of attention to the panel to get the same information.

Got Sirius satellite radio? You can control it from Pilot on the tablet. Often the pilot(s) are too busy to bother with entertainment like this. So, a passenger with a suitably equipped tablet (two are supported at once by the FS 510) can fiddle with the audio.

For the well-equipped among us, the FS 510 also allows remote control of Garmin's GSR 56 Iridium satellite device from Pilot on Apple, allowing users to send and receive text messages and even make phone calls.

Finally, if you have a compatible EFIS, attitude data from that EFIS is sent to your tablet for use on the derived-instrument page. At first we assumed this capability included air data from the EFIS, but it does not. So, the instrument page on your tablet displays the attitude from your EFIS AHRS plus groundspeed, track and GPS altitude, but not airspeed, heading or pressure-derived altitude.

But, since you have EFIS in the first place to even just get the attitude, all the other raw data presumably is available. Why not display it on the tablet, thus making your tablet a first-rate EFIS backup if you have a display failure? We asked Garmin about this and they agreed it was a desirable feature, but they currently have no specific plans to add it.

COMPATIBLE, MAYBE

If you're considering a Flight Stream 510, there are a few more things for you to consider. The list of compatible avionics today is quite limited (Garmin's GTNs, the G500/600 and the new G1000 NXi). Just because you have compatible avionics doesn't mean they actually are compatible.

The obstacle is the operating software in the panel-mount boxes themselves. When the FS 510 was first available, there was a short delay before even the requisite software for the GTNs was available. Then it was another two months before the update for the G500/600 was released. By the time you're reading

this, all requisite updates should be readily available, but you'll still need to install them or that $1495 FS 510 will be no more than a very expensive memory card.

Garmin has released a lot of new and useful features for both the GTNs and the G500/600, so you might want to at least consider the updates anyway. While the updates are available at no charge, they must be installed by your shop, so there's probably going to be a labor charge. The labor to update your entire panel shouldn't be more than an hour or two, but it's a cost you should consider in your FS 510 purchase.

Oh, and you should also check with your shop about the software level of the FS 510 itself. The one we installed already had an update that was released to correct a few anomalies we experienced.

VALUE COMPARISON

The hard-wired Flight Stream 210 is still available and costs about $1000—that's $500 less than the FS 510. However, the FS 210 requires a non-trivial effort by your dealer to install. All in, we've seen FS 210 installations cost as much as $2000.

Then, there's the 2020 mandate for ADS-B. Garmin is selling its GTX 345 ADS-B transponders as fast as dealers can install them. The GTX 345 includes some Connext inflight features, but lacks flight plan transfer; spending $1500 more for the few missing features is no bargain.

Plus, of course, if you have GNS navigator(s), the FS 510 isn't an option. However, if you're considering—or have already traveled—another route to ADS-B compliance and you have a GTN navigator, the FS 510 makes a good choice.

We don't feel the wireless database update is compelling by itself, but when viewed with the other features, it's a bonus that can make the decision. If you have two GTN navigators and/or a compatible EFIS, then the wireless update becomes a meaningful time saver and is worth a serious consideration.

Frank Bowlin, editor of sister publication IFR, installed an FS 510 in his Cessna 340 for this report. Compared with the airliners he used to fly, he says he now gets more information more simply, faster and with similar redundancy.

PILOT ACCESSORIES

Lightspeed Zulu3: Quality Meets Comfort

It's simpler than the flagship PFX, a step above the already good-performing Zulu2 in comfort and durability, plus it's $250 less than a Bose A20.

by Larry Anglisano

In our view, Lightspeed's recently introduced third-generation Zulu3 ANR headset is a nicely executed improvement to a product that already works well. Its predecessor—the Zulu2—excelled in a crowded market of high-end ANR models because it was simple, comfortable and had the modern features buyers want, but at a price that's substantially cheaper than a Bose A20.

Better yet is Lightspeed's commitment to its loyal customer base. Recently bought a now discontinued Zulu2? Lightspeed founder and president Allan Schrader understands your pain, so he's put into place a reasonable Zulu3 upgrade program.

Is that worth the $150 upgrade, or for new buyers, $850 for a new set? We tried the new Zulu3 to find out.

SOME PFX, ALL ZULU

The Zulu3 is far from a complete redesign and the company resisted dragging in the complex feature set that it packed in the flagship PFX model. We think that's a good thing. While we were impressed with the overall performance of the PFX when we put it head-to-head with other flagship models in the October 2015 issue of *Aviation Consumer*, we're not so sure all buyers are wowed by its bold design, or tolerant of its huge control module.

But by fitting some of the PFX's (and the wireless Tango's) smartly constructed hardware to the Zulu3, including the Kevlar braided audio cable, plus the performance earseals, the set takes on a new level of quality and durability, with a higher-end feel than the Zulu2.

The most common component to fail in virtually any headset is the audio cabling, but you would have to try pretty hard to trash the Zulu3's Kevlar-wrapped cabling. Pull on the them hard as you like—they won't break. Lightspeed is so confident in

The all-metal Zulu3 retains the same headband as the Zulu2, but the new earcups deliver more comfort, especially when fitted with eyeglasses.

The Zulu3 is a snug fit, but we didn't feel any pressure points that contribute to fatigue. The control module, bottom photo, is refreshingly simple, while pairing to a smartphone couldn't get easier.

the Zulu3's build quality it sends a new set out with a seven-year warranty, and a two-year warranty for an upgraded Zulu2. There's also a 30-day money-back guarantee.

Compared to the Zulu2 (which was plenty comfy, in our view), the 14.6-ounce Zulu3 has an edge, at least on our heads. Part of the improvement is courtesy of new earseals that Lightspeed says have 20 percent more surface area than the leading competing headset—which we assume is the Bose A20. The extra surface area helps to accommodate eyeglass temples, it better distributes side pressure and simply provides a better seal around the ear. Unless you're Dumbo, the wide cavity of the earcup fits over the entire ear. That eliminates a painful pressure point.

The Zulu3 retains an all-metal construction and the headband is unchanged from the Zulu2. It's rugged and easy to fine-tune. If your ears aren't centered in the cup, Lightspeed offers taller complimentary headpads.

JUST ENOUGH FEATURES

This includes Bluetooth circuitry that's easy to pair, plus a reasonably sized and utilitarian-designed control module with auto shutoff that houses two AA batteries (40 hours endurance, but less with Bluetooth) and simple sliding volume controls. There's also volume controls for Bluetooth audio.

To our ears, stereo music quality in the Zulu3 is better than it ever was. We suspect this has a lot to do with the efficient fit of the earpads and reworked speakers. There's also Lightspeed's Front Row Center built-in cross-feed stereo enhancement, which creates a theater-like effect. In our view, the quality is on par with that of the AKG AV100 headset—which we declared a music-quality leader in our last roundup.

The Zulu3's ComPriority feature automatically reduces the music and audio level from connected auxiliary devices (wired and Bluetooth) when a radio breaks squelch. Activate it with a single button on the control module.

We didn't need to mess with it, but the set has a microphone gain adjustment pot accessed by removing the windscreen. This can be helpful for boosting sidetone.

FLIGHTLINK APP, UPKEEP

Like the Zulu2 and PFX, the Zulu3 works with Lightspeed's free Flightlink app, which has a wireless audio playback recorder and playback for comm and intercom activity. The app can be used while toggling other apps on Apple devices.

Worth mentioning is that Lightspeed suggests replacing earseals, headpads and mic muffs every 18 months. Plan on $50 for all of them.

The Zulu3 can be ordered with standard ("GA") audio plugs or with a Lemo panel power cable. The set comes with a high-quality storage case and two AA batteries. List price is $850, and as we noted, you can upgrade a Zulu2 for $150.

As with any headset, we suggest trying the set for 30 days. Based on our trials, we suspect you'll like it enough to keep.

Visit www.lightspeedaviation.com.

HIGH-END ANR HEADSETS COMPARED

MODEL	PRICE	WEIGHT	BATTERY LIFE	AUTO SHUT-OFF, AUTO MUSIC MUTE	COMMENTS
AKG AV100	$1099	13 ounces	50 hours	yes	Excellent music quality, clever earcup flashlight function, music play/pause control, notable comfort, but mediocre ANR performance.
BOSE A20 BLUETOOTH	$1095	12 ounces	45 hours	yes	Consistent favorite among our diverse group of evaluators, advanced Bluetooth and multiple inputs are configurable for priority, simple in-the-field Bluetooth upgrade for older A20 models, poor passive performance.
DAVID CLARK PRO-X	$637	7.5 ounces	50-plus hours	yes	Good value for the price, on-ear design is less intrusive, but ANR quality is a tradeoff, fold-flat storage, no hard-wired input for music.
LIGHTSPEED ZULU PFX	$1100	14 ounces	22 hours	yes	App-configurable software makes it the most advanced model on the market, excellent ANR quality, battery life isn't great, control module is too bulky for our liking.
LIGHTSPEED ZULU3	$850	14.6 ounces	40 hours	yes	Excellent build quality, fit and finish, Bluetooth entertainment audio quality is much improved over earlier models, simple control module.

Crumped Crankcase? Lycoming Cuts Prices

If the shop can't repair your cracked Lycoming case, prices on new ones are reasonable. Repaired Continental cases are the high-value choice.

by Paul Bertorelli

Surrendering your engine to an overhaul shop has a bit of a dice roll to it. Shops quote prices for the overhauls, but they're based on a "repairable or serviceable core." That means a good crankshaft and a crankcase and either or both could be junk, propelling the overhaul into blank-check territory in the blink of an eye.

Even though they're just a lump of cast aluminum, crankcases do wear out and before that, they sometimes crack. Is it better to replace a knackered case with a new one, fix what you've got or let the shop draw an overhauled case from the repaired inventory pool? That last option is by far the real-world solution of choice, but there may be circumstances where a new case is justifiable.

The good news for Lycoming owners is that the company has recently, and quietly, dramatically reduced prices on new crankcases and we're not talking a measly 15 percent, but more like 60 percent. That doesn't automatically argue for a new case, but it makes it more palatable if yours is irredeemable scrap.

CORE IN, ENGINE OUT

Most overhauls these days take at least six weeks and some take longer than that. The bottleneck, shops tell us, is sending crankcases out for rework and getting certain parts from suppliers, either the two major manufacturers or the PMA houses that ply the overhaul trade. When turned in for overhaul, all crankcases need some work, ranging from minor cleanup and dressing of mating surfaces to more major work, like weld repairing major cracks, line boring for the bearing webs and reworking the tappet bores. Most overhaul buyers don't see this on the invoice because it's included in the price of the overhaul.

"Our pricing is conditional that the case be serviceable," says Allen Weiss of Certified Engines, which was in the midst of moving from Opa-locka to North Perry Airport when we called. "Same thing with a crankshaft. But a lot of times, a case rejects and you have to hit them with a core charge," he adds. So what does serviceable mean? The exact definition probably varies by shop, but it universally means that at least the case meets the specifications described in the approved overhaul manual.

It specifies specific dimensions for main bearing and tappet bores, the condition of the mating surfaces and accessory case bores, deck height and so forth. Most cases coming in for overhaul require at least some work, but perhaps 20 percent get by with just cleanup and inspection, says Tim Hansen, at Penn Yan Aero in Penn Yan, New York. There's some variability in what constitutes a serviceable or repairable case. Hansen says Penn Yan promises an overhaul to new dimensional limits, not service limits, as some shops offer. The shop also backs that up with a long warranty—five years or TBO, whichever comes first.

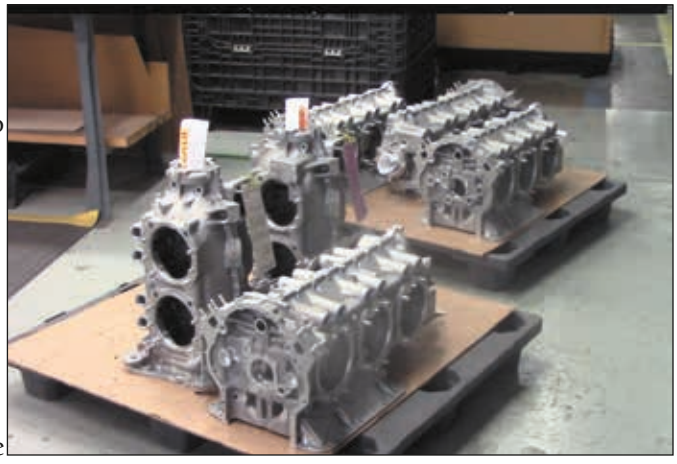
At the other end of the spectrum are crankcases that arrive beaten down to the limits of reparability, with worn bores, fretted mating surfaces and cracks that may or may not be weldable.

A cracked crankcase might not have to be taken out of service if it's discovered on the mount. In fact, Continental has a service bulletin describing continued service with minor cracks. But during overhaul, cracks must be repaired or the case replaced; no overhaul manuals allow cracks.

THE POOL

AC 33-6 describes in detail the repair processes used for crankcases and cylinders. Weld repairs are allowed in crankcase bores, in supports, webs and fillets of the bearing bores and around stud holes, cylinder decks and mating flanges. Cracks up to 3.5 inches are considered repairable, but anything longer is not.

Not all crankcase repairs require welding. In fact, many don't. Things



RAM Aircraft, top photo, keeps serviceable cases in stock. Prices on new Lycoming cases, lower photo, have been sharply reduced.

Typical crack in a large-displacement Continental case, top. It's unrepairable. As part of case overhaul, mating surfaces are cleaned up and trued, lower photo.

like worn tappet bores can be bored and fitted with oversize sleeves and main bearing bores, which wear out-of-spec due to fretting between the case halves, are routinely line bored to restore an aligned bed for the crankshaft. Where crack welding is required, all evidence of the crack must be removed, welded and the entire case heat treated. It sounds like a complex process and it is.

That's why most engine overhaul shops send their crankcase work to one of two major vendors in the industry—DivCo or Crankcase Services, both in the Tulsa, Oklahoma, area.

YouTube See a video about cam corrosion at http://tinyurl.com/j95ht2a

Turnaround time is typically six weeks and shops tell us this is almost always the bottleneck in turning around engine overhauls, although obtaining some parts can also slow things down.

For this reason, many shops maintain a pool of repaired and serviceable cases. If a core has a cracked but repairable case, the shop will draw one from its pool and send the cracked case to Oklahoma for repair. Owners also have the option of buying a new crankcase and some choose to do that.

"The problem we're running into currently is that the customer doesn't want to pay the upgrade charge for that new product because it's really not reasonable," says Stephen Boggess of RAM Aircraft in Waco, Texas. They're a Continental specialty shop with a focus on the 520/550 series, but they also overhaul some Lycoming engines.

When we spoke to Boggess in late February, the shop had 67 serviceable cases in stock covering just about all of the large-displacement Continental engines. These typically sell for less than half of the cost of a new case, which can top $10,000. Since shops must stand behind their engines with increasingly competitive warranties, it's fair to ask if a repaired case really is as good as a new one.

"The key thing is was the repair done right, " Boggess explains. "Honestly, the biggest reason we find for cracking is maintenance. These engines don't get to TBO without some cylinder work. We found that a lot of engines with cracking have had some kind of cylinder work done in the recent past. And maybe they didn't get it torqued properly or to the right amount. That has proven itself in the logbooks," he adds.

Certified's Allen Weiss agrees that properly repaired cases are no more likely to have cracking or other issues than new ones. Certified builds about 300 engines a year and Weiss says the shop might see a return on a case once a year, if that. Although vendors like DivCo will stand behind their repairs, they don't reimburse the engine shop to break the engine down and redo the overhaul. Certified stocks more cases than any other shop and had about 150 when we interviewed Weiss in February. They often sell to other shops that don't keep a repair pool on hand or who can't wait for a turnaround repair from DivCo or Crankcase Services.

A handful of shops are approved to do their own repairs. Penn Yan Aero is one and Central Cylinder Service in Omaha, Nebraska, is another. They work to the same standards observed by the specialty crankcase vendors, but can offer faster turnaround for customers.

While there are a lot of old crankcases out there that have been beating around for 30 or more years, shops we contacted don't establish any limits for maximum hours on a case they'll put back into the field. "We believe in having them repaired if they meet standards," says Certified's Weiss. "For us, it has more to do with how many overhauls the case has had, not total hours. Two or three overhauls is the limit for us," he adds.

Crankcases have only so much metal to work with and when the mating surfaces are re-machined and the bores line bored, the dimension between the crank journal centerlines and the top of the cylinders—the so-called deck height—necessarily gets smaller. If it gets small enough, the piston won't have enough clearance on the compression stroke and the case is ready for the scrap yard.

SHIFTING COMPETITION

As the field overhaul shop universe has contracted, so too has the range of parts suppliers shrunk and become more competitive. Until recently, for instance, Lycoming and Continental cases were supplied by the original manufacturers, ECI and Superior, plus the aftermarket repair pool. But ECI was bought by Continental in 2015 and that rearranged the market. ECI no longer competes with Continental on its own cases, although it does compete with Lycoming for Lycoming cases.

Furthermore, Continental has shifted its distribution predominately

to Aviall and prices have escalated, according to shops we spoke to.

Lycoming did some rearranging of its own in response to this. Quietly at the end of last year, it drastically reduced prices on crankcases and crankshafts and not by a little. Heretofore, the company sold crankcases only as kits, which included such accessories as through bolts and spacers.

"A lot of shops don't want those parts," says Lycoming's Steve Palmatier, so the company broke the package into discrete parts. Furthermore, he says, Lycoming did a reset on costs and margins and routinely reviews everything in its parts catalog. "We looked at costs on components and the selling price and sales volume and realized we aren't selling any of these," Palmatier adds. Just as a for instance, the price on one case—an IO-360 with flat tappets—was dropped from $17,501.63 to $4979.65, a decrease of a whopping 72 percent. Palmatier told us some products are a little more than others, but this range of price reduction is typical.

The industry noticed. "Just overnight, the industry lost about a million dollars on that deal," says L.J. Warren, president of Zephyr Aircraft Engines in Zephyr Hills, Florida. He's referring to the investment some shops have in inventory of repaired cases. What used to be a breathtaking upcharge for a new crankcase is now far more affordable.

"When they're already spending that much money on an overhaul, $900 extra to get something new rather than something used and rebuilt, they'll almost always buy the new one," says Central Cylinder's Dan Czarnecki. Other shops report similar responses from customers. Lycoming's move upended the crankcase market but, unfortunately, only for Lycoming cases. Continental crankcase prices remain relatively high. "We really need Superior to step up in this market," says Weiss of Certified Engines.

RECOMMENDATIONS

With Lycoming cases priced so reasonably, we think any owner who needs one because the core case is junk should tilt toward new. Shops say new Lycoming production is less likely to crack because of product improvements so saving $1000 on a repaired pool crankcase hardly makes sense. If the submitted core needs a repair, that's already baked into the overhaul quote so it probably doesn't make sense to upgrade to new.

For Continental owners it's more complicated. New cases are still expensive, perhaps adding a third to the cost of the basic overhaul. A repaired case will cost half that, if not a little less. The good news is that repaired Continental cases seem relatively abundant so for most popular engines, there shouldn't be a delay in getting one to keep the overhaul perking along.

CAMSHAFTS: STILL A PROBLEM

Our interviews with engine shops revealed a troubling trend that may be getting worse. "The number of camshafts and tappets we see with spalling is epidemic," says Allen Weiss at Certified Engines. While other shops see the same thing, they don't necessarily agree on the cause or the frequency.

While spalling turns up when engines are broken down for overhaul, it's also common on engines sent in after a prop strike—even low-time engines. While some shops say it has to do with low utilization, Weiss told us Certified sees it in frequently flown flight school aircraft.

So what's going on? Greg Merrill and Ed Kollin think they've found a smoking gun. Merrill is general manager of Aircraft Specialties Services, which does cam and tappet overhaul, and Ed Kollin developed the Camguard oil additive marketed by Aircraft Specialties.

Independently, Merrill and Kollin picked up a pattern in aircraft logs related to cam spalling. They noticed that engines that had spalled cams and tappets were frequently topped within 100 hours of the cam going south. Kollin's theory is that before the cylinder is broken in, it has about 10 times the combustion blowby that a fully broken in cylinder would have. Blowby gasses get past the rings and load the oil up with undesirable combustion byproducts, including lead salts, water and unburned fuel.

Kollin also believes that the oil gets contaminated with a family of chemicals called hydroperoxides, also a combustion byproduct. He says hydroperoxides have a unique—and damaging—ability to prevent lubricating oils from forming a protective film on the surface of wear parts. Cams are especially vulnerable because the contact surfaces between the cam lobes and the tappets are under as much as 100,000 PSI of pressure.

The lack of an oil film, Kollin says, causes microwelding or microscuffing that begins with minor pitting. The pits create stress risers and eventually cause the surfaces of cam lobes or tappet faces, or both, to progressively degrade.

When new cylinders are installed on an engine, the recommendation is to operate it on straight-weight mineral oil for 25 hours. But Kollin says that's too long and should be limited to an hour, after which the oil should be changed and the engine run for another 10 hours on mineral oil before switching to an AD type.

Kollin also believes subtle changes in oil formulation contribute to the process. Aeroshell, for instance, used to contain more sulphur than it does now. Sulphur is a natural lubricant and is antagonistic toward hydroperoxides. Lower flying activity contributes by adding potential corrosion into the mix. Kollin and Merrill say the solution is to simply change the break-in oil much sooner than is usually recommended.

Washing and Polishing: DIY The Right Way

A spiffy machine proves you take pride in ownership, but using the wrong products and technique can induce corrosion and trash pricey paint work.

Staff report

Even the best professional aircraft detailers or products won't be able to resurrect some neglected paint finishes. That's why it's important to preserve the paint finish early with regular cleaning and polishing.

Far from a mindless chore, there's more to do-it-yourself cleaning jobs that you might think, including protecting expensive accessories like antennas, de-ice boots and propellers. Like any other job you might tackle yourself, there's a right and wrong approach to cleaning the aircraft. Here's how we would do it.

PLAN THE JOB

Before committing to an entire weekend spent in the hangar (that's how long it can easily take to get the job done), you should be aware of the regulations at your airport. Many only allow washing in dedicated wash areas in respect for environmental considerations.

Know what power tools and household cleaning products should stay at home. This includes power washers. Ever see the damage a washer can do to pressure-treated deck wood? The same water pressure can easily dent aluminum aircraft skin. It can also blast soapy water into lap joints—a setup for corrosion.

Even if you use spigot pressure from a plain-vanilla garden hose, you need to be extremely careful where you point the nozzle. We've witnessed FBO line workers blasting water directly at static ports during wash jobs, and the resulting expensive static system work that often follows. Worse is dealing with the results of frozen static lines when you're airborne. But there are other systems worth protecting and the aircraft's operating manual might offer some guidance.

For instance, the Beech Bonanza manual has several pages dedicated to washing considerations. It says to cover up the brakes and disks with plastic wrap, use caution around the trim tab piano hinges and attaching hardware and to avoid using pressure washers directly on the airframe.

You'll also want to avoid spraying control cables and pulleys—easy areas to inadvertently blast with the hose. The risk here is washing away lubricant from greased fittings. If you've been neglecting the fuel cap seals, an aggressive washing will send water into the fuel tanks. Sump the tanks especially well after washing.

THE WRONG CLEANERS

Before raiding your spouse's kitchen cleaning cabinet, consider that common household alkaline type cleaners can be particularly harmful when it comes to accelerating corrosion. This is especially the case in aluminum and magnesium alloys. Hydrogen embrittlement is an environmentally induced failure process, and high strength, highly stressed aluminum or steel alloys are particularly susceptible to this process. The release of atomic hydrogen is a cathodic product of many chemical reactions, and can come from some alkaline cleaners, without chemical buffers.

For more information on all forms of corrosion see the FAA's AC 43-4A on corrosion control. It's an excellent document for reference. Another is AC 43-205, which addresses approved cleaner standards. Absent of these documents, read the label. Formula 409, for example, says it's not for use on uncoated aluminum. The Fantastik cleaning product will easily lift chalky paint if it isn't diluted, so you might

It's crummy work, but keeping the belly clean of blowby oil and grease preserves the life and performance of antennas. A coat of polish makes it easy to maintain.

finally put the final nail in the coffin of your ancient paint surface.

While we used to use it freely around the shop, the run-of-the-mill Simple Green degreasing product isn't recommended on aluminum. The same is true for other household cleaners. Instead, get the version of Simple Green that's specifically made for aircraft use. It meets the Boeing specification as an approved cleaning agent. You'll find it at many aircraft parts suppliers, including Aircraft Spruce and Specialty and Sporty's, to name a couple. You can use it full strength (for degreasing neglected bellies, for example), or diluted.

We commonly see Varsol (aliphatic naphtha, a mild, petroleum-based cleaning solvent) being used in the shop to rid stubborn belly grease and inside the engine bay, but this may not be the best solution for do-it-yourselfers. Still, understand that mild detergents you might use to wash your Corvette just won't be strong enough to clean your Cessna.

For all-around cleaning and airframe washing, many pros we talked with like Woolite (or an equivalent liquid wool-garment surfactant) and warm water, in a ratio of two ounces of Woolite to a gallon of water.

While it's tempting to hit the local auto parts stores for bug remover products, use them carefully. When those big bad-ass southern bugs are a problem, we prefer a Woolite/water mix, applied with a regular sponge, then a kitchen sink scrub-sponge (you know the kind: regular sponge on one side and a tough, thin pad on the other). If that doesn't work, you might carefully try a nylon pot-scourer—maybe for really tenacious bug remains. Any bug splotches that can't be lifted by this should be washed, left to dry, then taken up one at a time with semi-abrasive polish applied with cheesecloth, using heavy up/down finger pressure.

As for automotive protectant wax, professional aircraft detailers we consult with advise not to bother using them on aircraft. Due to the friction that can build up during flight, an automotive wax will probably last one or two flights. Additionally, automotive waxes may contain carnauba and silicones, which can cause a buildup of static electricity and possibly cause interference with flight instruments and radio reception.

There probably isn't much you or the pros can do for the spent paint surface on the Cessna in the top photo. You can make it even worse by using some household cleaners. Part of your cleaning job should include refinishing the de-ice boots—a task that can be labor-intensive to do correctly, middle. Washing the airframe with a brush is an easy way to snap a static wick, bottom. Use your arms instead.

The market has no shortage of aircraft-specific polish and we'll cover them in a separate article. For now, understand there's a sizable difference between polish and wax. Apples and oranges, actually. Think of polish as a paint cleaner containing abrasives and chemicals to remove oxidation, light scratches and environmental deposits such as bird droppings and the dirt and grime that makes the painted surface rough. A wax is simply a protective coating applied to a polished surface—like what you put on an automotive finish.

START BUFFING

Once you have the paint surface clean, your eyes will immediately focus on any unsightly paint oxidation. If your eyes can't spot oxidation, your fingers can certainly feel it. If the paint surface feels chalky and rough to a clean, smooth finger, it's oxidized. You'll have some work ahead of you.

If there's a little oxidation but the paint looks OK, you can just polish it with the buffer. If it's been a long time since the plane has been polished—say a few years—and it's not hangared, there's probably a heavy coat of oxidation. Got a power buffer? You'll likely need one.

Still, it might not make your work any easier because heavy oxidation is a bear to remove—sometimes too stubborn for a wimpy drill spinning a buffing wheel. In fact, it could make it even uglier. You might get halfway through the oxidation layer but the rest will be swirled into the paint by the motion of the buffer.

For heavy oxidation, you'll need a high-speed tool, like a Milwaukee heavy duty polisher (to name one respected brand) using either polish or possibly a polishing compound. If you've never used a high-speed industrial polisher/buffer, your aircraft is not the thing to practice on. Get too aggressive and you'll spin the paint right off the surface of rivets or for poorly prepped paint surfaces,

TIPS FOR WASHING AND POLISHING

- ✔ Only wash the aircraft in approved areas or wash bays.
- ✔ Do not use damaging pressure washers.
- ✔ Avoid spraying water on static ports and control cables.
- ✔ Sump the fuel tanks particularly well after washing.
- ✔ Many household degreasers and cleaners can damage the skin.
- ✔ Learn to use an electric polishing buffer beforehand.
- ✔ If equipped with de-ice boots, keep them clean and well sealed.

you might strip the paint on flat surfaces. Using a buffer that has a trigger lock makes the machine easier to handle and provides a constant force on the surface. Use a polishing grade cotton bonnet for the buffer (have several on hand) that are large enough to efficiently do the large surface area of a typical GA aircraft. Think in terms of polishing several mid-sized cars. You've got a lot of area to cover. Most detailers we've watched start at the tail because it has the most detail and is the most time consuming. Again, the tail section probably isn't the place to learn how to use the buffer. Try the belly, in case you dork it up.

We suggest not squirting the polish directly onto the aircraft's skin, but instead onto the bonnet. If you leave the polish on for too long there's a good chance the paint will discolor. Also, avoid polishing in direct sunlight and be sure there is always polish between the bonnet and the skin.

You want to keep the buffer moving (which also helps spread the polish out) and not stay in one spot too long because excessive friction can damage the paint. You'll know when you need to apply more polish to the bonnet when you start to see swirl marks in the paint. This will be even more obvious on oxidized surfaces. Conversely, you'll know when you're going a bit too heavy with polish because it will be flying all over the darned place. Be sure to wear safety glasses and always apply the polish from the top to the bottom of the aircraft. We got lazy once when polishing a Cessna equipped with vortex generators and destroyed the bonnet when it hit a VG. Luckily it took out the bonnet and not the structure. Remember, you'll be working some areas by hand simply because the pad will be too big to effectively get the area around wing flap gaps, engine inlets, rubber trim and around antennas.

The right way to polish and remove even the slightest amount of paint oxidation is to use a high-quality electric polishing machine with cotton bonnets.

You'll find that working a 4-foot section at a time yields the best results. Since sections of the aircraft surfaces won't always be exactly flat, you'll need to hit indents, rivet lines and seams by side-cutting with the buffer.

You'll find that the effort requires endurance and good balance. It might be helpful to have a rolling shop stool, but when you move the buffer underneath the wing, get as much of the skin as possible while standing up. It's harder to polish when kneeling or sitting down. When standing, hold the buffer against the aircraft skin by lifting up with your legs, the same way you would lift a heavy object.

Last, keep a blanket handy for draping over completed areas of the airframe because any polish that splatters on a completed surface will have to be buffed again.

Once the surface is polished, you'll want to protect it. Paint shops tell us that silicon-based compounds can create problems when it comes time for paint touchups. As noted earlier, automotive waxes generally aren't for use on aircraft. Better are the modern polymer and acrylic-based products. One popular polymer coating we've used is RejeX from CorrosionX Aviation. We found that it makes removing bird droppings and other contaminants pretty easy, plus it lasts a long time.

DON'T FORGET THE BOOTS

Cleaning and protecting de-icing boots is a job in itself. It requires a fair amount of prep work and leading edge boots aren't wipe-it-clean accessories. The reward is a high-gloss finish and protection from harmful UV rays. It sure beats paying for new boots.

The pros refer to detailing de-ice boots as a refurbishment process because that's pretty much what you're doing. This includes stripping the old treatment and applying a fresh coat (several, actually) of boot sealant.

First, tape off the perimeter of the boots to keep the surrounding paint surface protected. This won't be too difficult because the boots are generally parallel with the skin surface.

CLEANING AWAY TURBINE SOOT

Fly a turbine aircraft and you'll be faced with cleaning the unsightly black coating of carbon exhaust buildup the engine spits out. On turboprops, the staining may be the heaviest around the area of the exhaust stack, but it can send black streaks of soot down the side of the fuselage. They make stuff for that.

We sourced a relatively new product called Turbine Soot Master from Real Clean Detailing Products, which claims the streak-free formula dissolves grease, carbon and oil without requiring any rinsing. The drill is to spray the solution directly onto the soiled surface, wait 10 to 20 seconds and wipe the area clean with a microfiber cloth until it's dry. There's no need to rinse the stuff off because the cleaner isn't caustic.

We tried Soot Master on a heavily coated exhaust stack and while it took a few tries to get it completely clean (trashing a couple of cleaning cloths) it was convenient and effective. There's no reason why you can't use Soot Master for other cleaning chores, including wiping away exhaust blowby grime from antennas, landing gear and other components. The company claims the cleaner is safe for all painted surfaces, although it will obviously strip away any protectant that's on the surface.

For carbon soot that's baked into the surface for a long period of time, the company sells the Streamline Speed Wax product. Rub it into the paint where it removes staining that Soot Master can't. We can't substantiate the claim because we didn't try it.

But we did try Real Clean's Post-Flight detailing spray. This is a liquid cleaner and polish intended for light-duty clean-ups. You know, park the airplane, hit it with a spray bottle filled with the stuff and simply wipe it off. It works well for removing bugs, fingerprints and dust, plus it contains micro-waxes that are safe for painted, aluminum, Plexiglas, polished plastic and wood surfaces. It leaves an impressive high-gloss shine and is easy to work with, even in direct sunlight. This makes it good for quick-turn ramp cleaning. A 12-ounce bottle of Soot Master is $12.95 and a 32-ounce bottle of Post-Flight detailing spray is $17.95. The company has an entire line of cleaning products that we'll look at in an upcoming product roundup. Visit www.realcleanproducts.

Once the surrounding area is protected, scrub the boots with an appropriate pneumatic boot cleaner and there are many to chose from. A few products we've used with good results are Arrow-Magnolia's boot prep and sealer (available at Sporty's), Pbs De-ice Boot System from Jet Stream Aviation Products (www.jetstreamproducts.com) and Plane Brite boot finish, although we couldn't find a current source for it.

Jet Stream Aviation offers a lifetime satisfaction guarantee for its Pbs product and those we talked with who have used the product swear by it, which is specifically approved by Aerazur—the company that manufactures the de-icing boots for Daher's TBM series turboprops.

Sponge on the boot prep and let it sit for a few minutes and agitate the surface of the boot with a clean, wet sponge. The goal here is to remove all of the old boot sealant. Next, saturate a microfiber cloth with clean water and wipe all of the prep from the surface of the boots. We suggest prepping the boots before polishing and protecting the aircraft paint because you'll have a dripping mess of old sealant. It's a sloppy job.

Once the boots are completely dry, it's time to apply the new boot sealant. This is best done with a microfiber sponge applicator. The microfiber will help keep lint from building up in the treatment. The key here is applying multiple coats of sealant, allowing each one to dry completely before applying the next. Jet Stream Aviation suggests layering on four coats of its sealant. You'll know when each coat is dry because the surface won't be tacky. We found that it's best to apply boot sealant on a relatively dry day because humidity will dramatically increase the drying time. Generally, once you get to the end of the boot, the rest of it should be dry.

You'll want to paint the sealant on in one direction and avoid going back once you lay a coat on because the sealant has self levelers built in, potentially breaking down if you keep messing with it. The first couple of coats won't look great, but the boots will take on a glossy, wet appearance after several coats. You might see air bubbles in the surface, which will disappear once the sealant dries.

Jet Stream sells the prep ($32.48 for a one-quart bottle) and sealant ($58.94 for a one-quart bottle) individually, or you can purchase the entire Pbs boot kit. It includes two quarts of Pbs sealant, four quarts of prep, two cans of the company's Powerfoam spray-and-wipe foam cleaner, two microfiber applicators, two scrubbing sponges and a rinse bucket for $259.90.

LEAVE IT TO THE PROS

If you don't have the time, or simply aren't comfortable with polishing your otherwise flawless paint job, you could bring it to the pros. And a pro who specializes in vehicles and boats might not have the skill or the tools to properly handle the job any more than you do.

For a small single, professional aircraft detailers might bill out a few hundred bucks for a complete external detail job, but that's much cheaper than the average paint job. Better yet, learn to do it yourself—the right way.

ICAO Equipment Codes: Avionics Specific

Flight planning with updated avionics? Figuring out the equipment coding needed for the FAA form 7233-4 can be bewildering. Here's a quick-reference guide.

by Larry Anglisano and Luca Bencini-Tibo

After delays, the FAA transitioned from the domestic IFR flight plan form (7233-1) to the 7233-4 International Civil Aviation Organization (ICAO) form this past January.

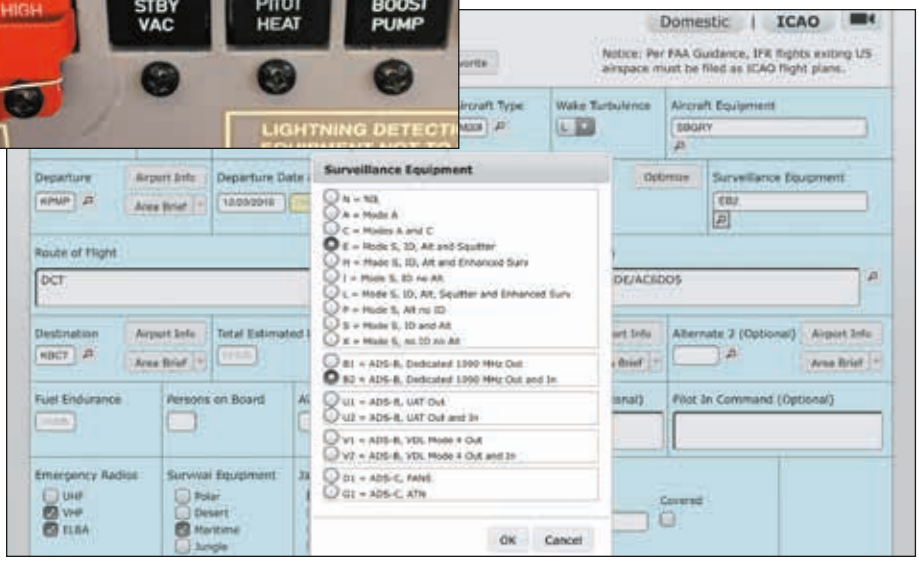
It's your ticket to flying in RVSM airspace and utilizing ADS-B services. Plus, you can use it for operating under VFR within the Washington, D.C., special flight rules area.

But sourcing the correct equipage codes required for the form can be a head-scratcher, especially after avionics upgrades. Worse, there's little standardization across the fleet when it comes to capabilities. That means the coding for a vintage LSA will be much different than it is for a Pilatus. What about a pilot renting a Piper Arrow or a G1000 C172? Flight schools need to keep the aircraft paperwork current.

The 7233-4 form is similar to the superseded domestic flight plan one, but it more heavily integrates PBN (performance based navigation) capabilities, and uses different terms for previously used data.

Two major differences are Item 10, Equipment, and Item 18, Other Information. Gone are the familiar equipment codes like /G for GPS with Mode C altitude reporting, as an example.

The revised equipment coding can be complicated because some codes represent the capability of installed equipment (B for LPV capability with a WAAS GPS) and authorizations (W for approval to operate in RVSM airspace), for instance. There's some overlap; flying in RVSM airspace requires installed equipment with appropriate capabilities and N-number specific FAA authorization. There are also various combinations for ADS-B equipment and communications radios.



PEELING THE ONION

Let's explore the most common codes that would be applicable to light general aviation aircraft. We'll skip the coding for large transport aircraft, like I for inertial navigation or H for high frequency communications. Some abbreviations are logical, others not so much. Hit the charts on the next page for the most commonly used codes.

For basic equipage, like VHF navcomms, S includes a communications transceiver, VOR receiver and ILS receiver. But say you have a version of the King KX155 that doesn't have an ILS receiver. You report OV, for having a VHF comm receiver, along with VOR nav receiver.

WAAS navigator installations approved for LPV approaches are coded as B. Non-WAAS GPS gets a G. And yes, the FAA still wants to know if you have ADF (that's an F) and D for DME. KR85 and KNS80, anyone?

VHF comm radios with 8.33 kHz channel spacing (most new radios are so equipped) are only relevant in European airspace, but are still coded with a Y on the form.

A simple tidbit to remember is the codes are written alphabetically, except for S—which always leads the abbreviation. Think in terms of an individual radio's capability.

In other words, SFG means you have a comm, VOR, ILS, ADF and GPS. SBFZ means you have comm, ILS, a WAAS GPS that's certified for LPV precision approaches, an ADF receiver and "other" equipment, which is the Z you would reference in Item 18 on the form. Here's where your research can go off the rails,

Adding equipment codes to the aircraft panel ID placard isn't a bad idea for on-the-fly reference. But more important is recording the updated codes in the aircraft POH or flight manual.

WHO KNOWS THE CODES?

It's logical to assume that avionics manufacturers do. Not exactly. While these companies know what they build and ship, they don't know how they ultimately get interfaced and configured once in the field. For instance, a transponder with ADS-B extended squitter output doesn't mean that the aircraft in which it's installed is ADS-B compliant. You could always call tech support, tell them what you have and see if they can link together the proper combination codes. In the end, we don't think it should all be on the manufacturer.

We asked Garmin if it offers guidance and indeed it does, to some degree. It sent us a chart listing Garmin equipment (dating back to first-gen GPS) with RNAV and RNP capabilities, with specific categories for compatible approach ops, including LPVs, RNP approaches with LNAV/VNAV capabilities and others. While this might be helpful for figuring out what capabilities your equipment has, it doesn't consider any specific interface. It made the caveat clear.

"We stress that our data is to be used as a guide for the qualifications that our equipment can support and is not a blanket statement of capabilities for all installations. Actual capabilities are subject to individual installation approval and operational approvals. Operators should refer to the equipment's AFMS (aircraft flight manual supplement) and if applicable, LOA, OpSpec/MSpec data," it said. That's logical. If you aren't familiar with the flight manual supplement that chases your installation (you do know where it is, right? It must stay onboard the aircraft), now is the time to read it.

What about the installing avionics shops? After all, they engineer the interfaces, based on existing and newly installed equipment, and they complete the flight manual supplement before signing off the installation. We asked a couple of shops if they brief the customer on equipment coding. We heard crickets.

Aircraft manufacturers may or may not be much help. After all, how in the world would they know how their fleet of aging aircraft are equipped? Moving forward, we hope that manufacturers of new aircraft document the equipment codes (as delivered, of course) in the POH much like weight and balance data is documented.

If you're venturing on an ADS-B upgrade, ask the shop to help identify the new/amended codes for your particular interface and be sure it gets logged.

COMMON SURVEILLANCE CODES

EQUIPMENT	CODE
Mode A Transponder	A
Mode C Transponder	C
Mode S Transponder w/ press. alt., aircraft ID	S
Extended Squitter ADS-B Transponder	E

COMMON EQUIPMENT CODES

EQUIPMENT	CODE
DME	D
ADF	F
GNSS/GPS	G
VHF Comm, VOR, ILS	S
8.33 VHF Comm Transceiver	Y
VOR Receiver	O
GPS WAAS LPV Approach	B
Other equipment	Z

COMMON ADS-B CODES

EQUIPMENT	CODE
1090 "Out"	B1
1090 "Out" and "In"	B2
UAT "Out"	U1
UAT "Out" and "In"	U2

especially if your aircraft is light on paperwork.

If the GPS is WAAS-capable, it's documented in Item 18 as NAV/SBAS, which stands for navigation via satellite based augmentation system. U.S. pilots know it as WAAS, but in other countries, it's a variety of names. In Europe, it's known as EGNOS, in Japan it's MSAS and in India it's GAGAN.

However, if additionally, the aircraft has PBN capability, then PBN codes are placed in Item 18 without putting information on SBAS. It's assumed that if the aircraft has WAAS GPS navigation capability, it also has PBN capability.

PBN CODES

A common question is whether you can file PBN codes, since they require approval. For Part 91 subchapter K (fractional owners), Part 121 and Part 135, the approval for each individual aircraft must be in FAA approved Management Specifications (MSPECS) or Operations Specifications (OPSPECS) as appropriate. Additionally, flight crews might also need to be approved. For Part 91 operations, the approval needs to be in the POH—specifically in the Airplane Flight Manual Supplement (AFMS)provided by the avionics OEM with a specific configuration. The exact language in a 2016 AFMS revision for a Garmin GTN Navigator is this:

"The Garmin GNSS navigation system complies with the equipment requirements of AC 90-100A for RNAV 2 and RNAV 1 operations. In accordance with AC 90-100A, Part 91 operators (except subpart K) following the aircraft and training guidance in AC 90-100A are authorized to fly RNAV 2 and RNAV 1 procedures. Part 91 subpart K, 121, 125, 129, and 135 operators require operational approval from the FAA."

ADS-B THROWN IN THE MIX

If equipment codes for familiar systems aren't daunting enough, documenting ADS-B capability is another one to keep straight. For instance, E represents a 1090ES extended squitter ADS-B transponder. But the E coding doesn't stand alone. You've got to elaborate.

The EB1 code reflects that the extended squitter transponder only has ADS-B Out. But if you have an L-3 Lynx 9000 or Garmin GTX 345, for example, you have both 1090ES extended squitter output, plus ADS-B receive capability. That's coded as EB2. Still with us? It gets worse.

Don't confuse panel GPS with the one used for ADS-B. If the aircraft is ADS-B Out compliant, it must also have a WAAS GPS source, but not necessarily a WAAS navigation source. It could be the WAAS GPS that's integral to the transponder or even a remote 978 UAT (universal access transceiver) system. These behind-the-scenes GPS engines provide the accuracy to the ADS-B transmission. Codes for UAT ADS-B gear are included with the transponder.

continued on page 32

Piper Navajo

Passengers like the Navajo's spacious cabin, while pilots enjoy pleasant handling and decent speed. No, this isn't an inexpensive plane to operate.

Regarded as one of the workhorses of general aviation, the Piper Navajo has found a substantial market in the charter business. But it's also an appealing twin for owners who want to fly themselves in relative comfort and luxury. Like the Cessna 402, as one example, you don't find many Navajos in private ownership, although some aircraft sales professionals we spoke with during our research told us that's changing—and good ones sell for a premium.

The Navajo model line is confusing. The PA-31 was produced in a half-dozen variants spanning two fuselage sizes over a 17-year production run beginning in 1967 and ending in 1984. All told, just over 1500 were built, the lion's share of them the long-fuselage Chieftain version. Many of these have found their way to Europe and the Pacific, where they are valued as commuter airliners.

Piper had to earn its bones in this market, since it had no experience in large commercial aircraft working the airline service cycle. The experience paid off, however: It led directly to the development of more sophisticated airframes, such as the turbine-powered Cheyenne.

Owners of Navajos tell us they love the airplanes but, as with any twin, these airframes simply can't be flown on the cheap. They require ongoing maintenance, the engine overhauls will consume much of $100,000 and the airframes virtually swim in ADs. That said, one owner sums up the Navajo's appeal this way: "The Navajo is a fine aircraft, capable of performing many missions. It is comfortable and stable, straightforward to maintain and operate, reliable and cost effective. Our passengers don't groan when boarding."

The Navajo series ranks up there with the absolute best-mannered Pipers ever in terms of handling.

MODEL HISTORY

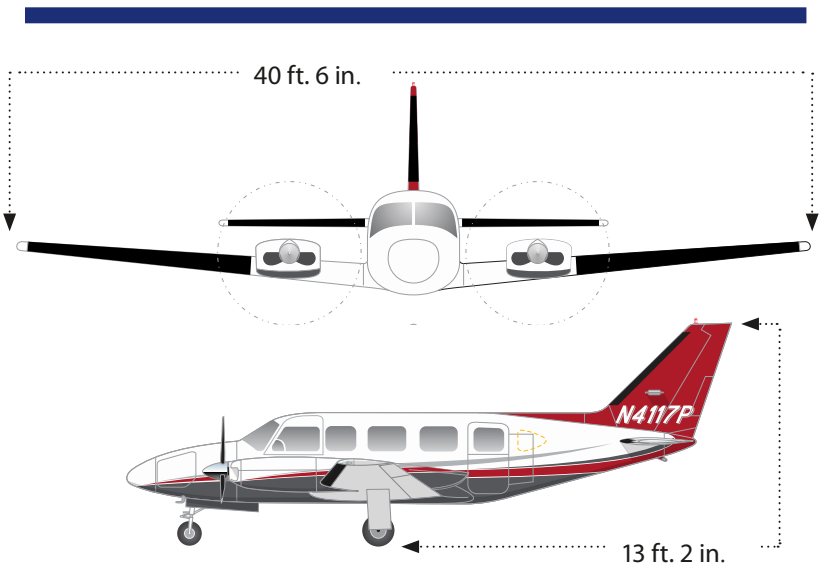
When the first Navajo appeared in 1967, it debuted with the likes of the Cessna 401 and 411. The high-class 421 came out a year later. Although Cessna had big-twin experience, Piper didn't, having been focused on airplanes like the Apache, Comanche and Tri-Pacer. Originally named the Inca, the PA-31 evolved from a relatively small twin into a large six-to-eight-place model, which was well received.

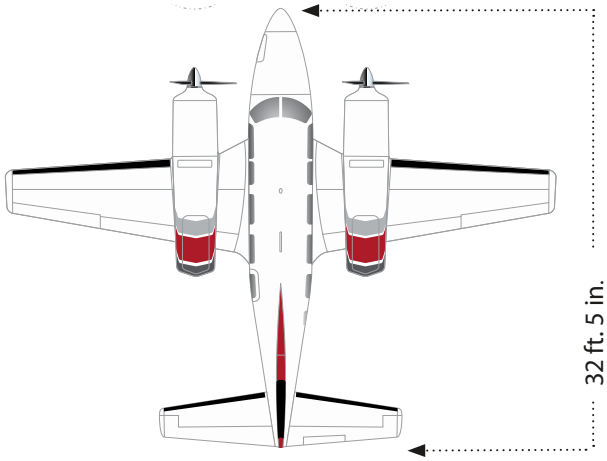
Initially, there were only two windows in each side of the fuselage aft of the cockpit, but this was increased to three rectangular windows with a smaller triangular one on the aft starboard side. The basic shape and arrangement held through the production life of the Navajo, yielding a cabin size almost large enough to stand up in.

The prototype flew in September 1964, powered by variants of the Ly-

The Navajo Chieftain like the pristine model operated by JetSmart Aviation in the main photo has a stretched fuselage and lots of ramp appeal.

PA-31-350 CHIEFTAIN



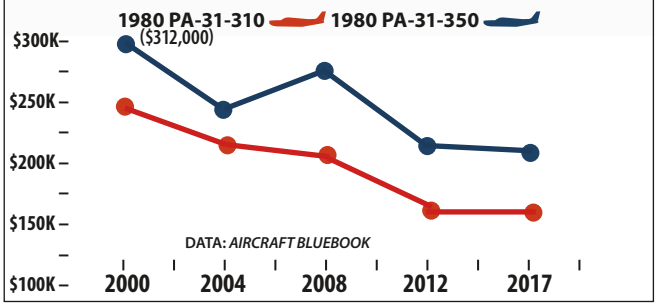


drawings courtesy
www.schemedesigners.com

SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1967 PA-31-310	LYC 310-HP TIO-540-A1A	1800	$50,000	190	2500 LBS	215 KTS	±$70,000
1975 PA-31-310	LYC 310-HP TIO-540-A1A	1800	$50,000	190	2500 LBS	215 KTS	±$130,000
1968-69 PA-31-300	LYC 300-HP IO-540-MIA5	2000	$40,000	190	2600 LBS	183 KTS	±$75,000
1970-76 PA-31 P	LYC 425-HP TIGO-540-E1A	1200	$50,000	192/242	2175 LBS	234 KTS	±$120,000
1978 PA-31-350	LYC 310-HP TIO-540-J2BD	1800	$50,000	182/236	2800 LBS	217 KTS	±$185,000
1984 PA-31-350	LYC 310-HP TIO-540-J2BD	1800	$50,000	182/236	2800 LBS	217 KTS	±$265,000
1973-74 PA-31-310B	LYC 310-HP TIO-540-A2C	1800	$50,000	190	2500 LBS	215 KTS	±$125,000
1976 PA-31-310C	LYC 310-HP TIO-540-A2C	1800	$50,000	190	2500 LBS	215 KTS	±$135,000
1982 PA-31-325C/R	LYC 310-HP TIO-540-F2BD	1800	$50,000	183/237	2400 LBS	196 KTS	±$230,000
1984 PA-31 P-350 MOJAVE	LYC 350-HP TIO-540-V2AD	2000	$50,000	242	2175 LBS	234 KTS	±$285,000

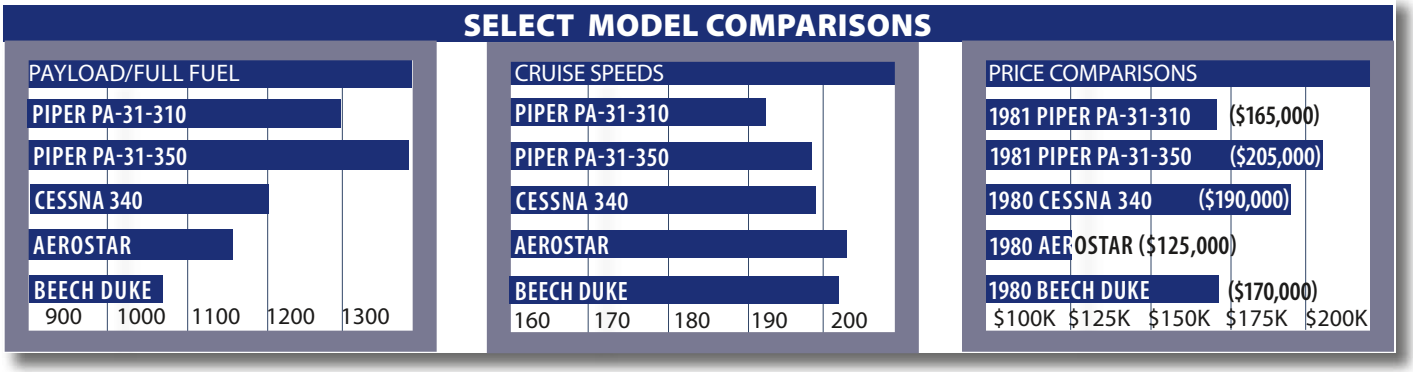
RESALE VALUES



SELECT ADs

AD 2003-24-07	INSPECT, REPLACE RUDDER TORQUE TUBE ASSEMBLY
AD 2001-06-01	INSPECT THE RUDDER AND ELEVATOR SPARS AND ELEVATOR BUTT RIBS FOR CRACKS
AD 2000-25-01	INSPECT, REPAR MAIN LANDING GEAR DOORS
AD 1999-12-05	INSTALL ELEVATOR SPAR ASSEMBLY INSPECTION HOLE

SELECT MODEL COMPARISONS



A Navajo has plenty of space on the instrument panel. That's a Garmin G600 PFD in the top photo and dual three-screen Aspen Evolution systems, plus JPI primary engine display, in the bottom image.

coming O-540 family that remained the powerplant of choice throughout the Navajo production run. The first model year had both normally aspirated and turbocharged versions. The launch model was the PA-31-300, powered by 300-HP IO-540-Ms with two-bladed propellers and a recommended TBO of 2000 hours, a bit better than the Continental engines used in the Cessnas.

While the 300 has the same 190-gallon standard fuel capacity as all unpressurized Navajos, max takeoff weight is 6200 pounds, compared to 6500 for all the other so-called "short-body" Navajos, while basic empty weight was only 156 pounds less than the turbocharged version.

The 300's production run was stunted: Only 14 were built over two years. The so-called "310" is really the standard Navajo. With turbocharged 310-HP engines, it could fly 30 knots faster, its single-engine ceiling was higher and it could take off shorter, plus, of course, the aforementioned extra useful load. This additional performance cost, on an average-equipped airplane, less than $10,000 on an invoice totaling about $130,000. It's easy to see why the 300 was dropped.

While some initially were designated PA-31-310 and called the Turbo Navajo, the FAA issued an AD in 1973 requiring that any called that have the data plate changed to a PA-31 model designation. Despite early problems with the turbo system, this is the second most popular version of the Navajo. Improved B and C models were introduced in 1971 and 1975, respectively. Radar appeared during this period, along with deice systems, although not all airplanes have it and some that do aren't certified for known ice.

As a nod to working pilots flying a working airplane, the pilot got his own overwing hatch so he wouldn't have to clamber over the cargo and passengers to get to work. In later models, the door was enlarged.

A number of refinements to systems were made along the line and not all are identified by changes to model designation. Field experience and maintenance issues were applied in a number of ways, such as improving the electrical system, including the location of circuit breakers and isolating wiring runs from sources of chafing and other deterioration. The cockpit was improved over the years, as was the appearance, comfort and serviceability of the cabin interior. When shopping Navajos, don't be surprised to find wide variation in interior appointments.

A three-blade propeller was offered as an option with the B model and made standard with the C. While many pre-1979 Navajos are equipped with some or full deice equipment, approval for flight in known icing (described at the time as approval for flight in light to moderate icing) was not obtained until the 1979 model year. Recommended TBO increased from the initial 1500 hours to 1800 hours. Also, there are special conditions under which this now can be extended to 2000 hours. This requires trend monitoring and approval from the FAA, for for-hire operations.

P-NAVAJO

The PA-31P (aka the PA-31P-425, or P-Navajo) was introduced in 1970. It was the most sophisticated, highest-performing Piper ever, with a big but troublesome geared version of the 540 series engine, the TIGO-541-E1A. The pressurized Navajo was cured of early problems with the pressurization system, but powerplant reliability has continued to plague the ambitious design.

The Lock and Key refurbishment package includes overhauled Lycoming TIO-540-J2B engines, top photo, with conventional-drive magnetos. Panther conversions include winglets, bottom. Combined with four-blade Q-tip propellers, climb rates are much improved over stock.

Initial recommended TBO of the 425-HP engine was an appalling 800 hours and even now, it's only 1200 hours.

Plan on spending $50,000 each for the overhauls. A high-ticket, short-TBO engine is a major cost factor in any airplane so owners of this model should budget $100 an hour just for engine reserve. Combine this with the fuel burn (mid-20s per engine) and you have a high hourly operating cost. Big engines also mean short range. A standard-fuel P-Navajo has an endurance in the three-hour range with IFR reserves. There was an optional fuel system available, which boosted range to a bit over four.

Production of the P-Navajo ended in 1977; a total of 259 were built. Prices on the used market range from about $120,000 to maybe $180,000, reflecting the high maintenance load. To put this in perspective, a Turbo Navajo of comparable vintage is likely to be worth $20,000 to $40,000 more, despite having 115 HP less per engine and no pressurization.

CHIEFTAIN

The largest and most successful Navajo, the PA-31-350 Chieftain, was introduced in 1972 as a 1973 model. The fuselage was stretched two feet (ahead of the wing) and the tailplane span increased. The cargo door was made standard. The power comes from counter-rotating L/TSIO-540-J2BD, 350-HP engines.

The floor was beefed up and an additional window added to each side of the fuselage. Up to 10 seats could be fitted. Empty weight increased by roughly 200 pounds and maximum takeoff by 500 pounds.

Extended nacelles provide baggage capacity and/or optional fuel tanks. The option raises total usable fuel from 182 to 236 gallons. The initial TBO of 1200 hours was increased to 1600 in 1979 and then 1800 (it, too, can be stretched to 2000 under special conditions). These engines cost about $50,000 each to overhaul.

Performance of the Chieftain is not too far off that of the P-Navajo, despite having less power. Combine this with the bigger cabin, less costly and troublesome engines and significantly more range through higher efficiency and it's easy to see why the Chieftain was so popular despite its lack of pressurization.

The T-1020 (model designation PA-31-350-T-1020) was an attempt by Piper to gain a larger foothold in the airline market. Called by some a stripped Chieftain, the powerplants were the same. It featured beefier components where experience showed weaknesses, especially elements affected by high cycles, such as doors, landing gear and gear doors. The interiors are also more durable. Up to 11 seats could be installed. Introduced in 1982, a total of 21 T-1020s were manufactured, making it a rare airplane; we found no cost data on it.

NAVAJO C/R

The PA-31-325 was introduced in 1975 as yet another iteration of the short-body fuselage. "C/R" means counter-rotating, reflecting the counter-rotating L/TIO-540-F2BD engines rated at 325 HP each that Piper selected for this model. Like the Chieftain, the C/R has extended nacelles with baggage lockers that can be used for additional baggage space or optional auxiliary fuel tanks.

NAVAJO NIGHTMARES: MAINTENANCE

As we completed our review of the 100 most recent accidents involving the Piper Navajo series, we found ourselves feeling sorry for the airplanes. Navajos are workhorses—by design—and many, if not most, were snatched up by Part 135 operators and have been capably carrying people and things all over the world for generations. In return they have been abused in all ways imaginable.

They have been the victims of awful maintenance. We found maintenance malpractice-induced fires and explosions in flight as well as engines, fuel and gear systems that were either not assembled correctly or run until they came apart.

Pilots added their own insults to maintenance injury when they demonstrated that they couldn't continue flight after shutting an engine down, often because they failed to feather the prop. They also regularly ran their airplanes out of fuel or decided to select tanks that contained air rather than others that held avgas.

Of those who managed to get to their destination more or less in one piece, 13 pilots decided to land without extending the landing gear—although we were impressed by the determination of the one who went around after he heard the prop tips and flaps hit the runway—he was able to extend the gear and land a second time, more quietly.

Of the pilots who did extend the gear, seven hit the ground so hard they caused structural damage to the airplane. One pilot thought he'd just blown the main tires, so he replaced them and kept flying. A few days later another pilot found missing rivets on preflight and called for further investigation—which uncovered extensive structural damage.

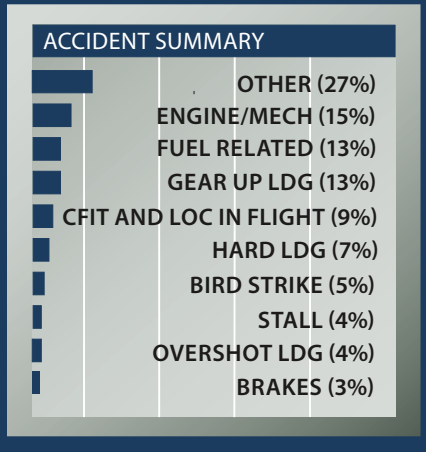
The fuel system on twin Cessnas often comes under attack for its complexity—yet the Navajo rate of accidents due to fuel mismanagement was 50 percent higher than that we observed last month for the Cessna 340. Of further concern to us for the Navajo was the rate at which pilots did not take appropriate action to keep the airplane in the air after shutting down an engine or following just a partial power loss in one engine.

We were also surprised at the unusually high number of gear-up landings—13. However, we only saw two events in which the pilot could not extend the gear due to a malfunction—a very good rate for piston twins.

There were nine accidents involving controlled flight into terrain (CFIT) or loss of control in instrument conditions. We were impressed by the chutzpah of the pilot who kept descending on a localizer approach in fog until he hit trees 600 feet below the MDA. He successfully went around. After diverting and landing, he claimed he'd hit birds. The evidence contradicted him.

There were five bird strike events, including one in which a pilot was confronted with a flock of geese shortly after liftoff. He dove in an attempt to avoid them and hit the ground. After landing not only was structural damage noted from the ground impact, goose remains were found.

One pilot aborted a takeoff when one engine's manifold pressure wouldn't come up to match the other. During heavy braking a wing "blew up." He got everyone out of the airplane safely.



Empty weight averages 90 pounds more than the basic PA-31. Cruise speeds are marginally higher, but range is marginally lower. Single-engine performance is improved although it's not noticeable when flown by the average pilot. According to the book, the basic Navajo has better takeoff and landing performance than the C/R.

The supposed advantage of the counter-rotating props is more handling ease in the event of an engine failure because—the promotional literature claimed—the dreaded "critical engine" is eliminated. In our view, this isn't much of a selling point. In the last year that both the PA-31 and PA-31-325 were offered (1982), the biggest factor was that the latter was about $20,000 more expensive than the straight Navajo. The difference hasn't changed much over the years: The C/R is still worth more than the straight turbo PA-31, by about $15,000.

MOJAVE

The last Navajo wasn't even called one. The PA-31P-350 was dubbed Mojave. It was a hybrid that reflected lessons learned over the life cycle of the extended Navajo family with a touch of Aerostar influence thrown in. The Mojave has a lot of appealing features, including a dual-bus electrical system, an O-540 variant engine supposedly designed specifically for high-altitude operation that included intercooling and pressurized mags from the factory, and thicker fuselage skins.

The L/TIO-540-V2AD engines are also counter-rotating, rated at 350 HP at 2575 RPM and have a recommended TBO of 2000 hours. Overhaul cost is around $50,000. Structurally, the wing is based on the Chieftain's. Span is four feet wider to improve climb and high-altitude cruise performance. The Mojave, the last twin Piper built in Lock Haven, Pennsylvania, didn't last a year. Introduced in 1983, the 50th and last rolled out the door in June 1984.

PERFORMANCE

The non-pressurized Navajo family is surprisingly close in book performance. All have a maximum operating altitude of 24,000 feet. (Forget service and absolute ceilings. This is the limitation that controls operation

Only 14 PA-31-310 "regular" Navajos were built. The one in the photo above made the wreck reports for impacting terrain during takeoff.

of the airplane). Speed and range at 65 percent below and at oxygen altitudes are within six knots and 150 nautical miles of each other. Multi- and single-engine rates of climb are so close (100 and 25 FPM at the extreme, respectively) as to be insignificant. So are stall speeds (from 70 to 74 KIAS) and all-engine landing and takeoff field requirements at gross.

The tricky part in performance is payload with full fuel. A corporate-configured Navajo can be carrying between 500 and 600 pounds of amenities, particularly if known icing and air conditioning options are included. A bare-bones airline Chieftain, on the other hand, might have 250 pounds or less added to the basic empty weight. So, payload with full fuel can range from a low of less than 800 pounds in a well-equipped C/R to more than 1400 pounds in a Chieftain.

Poorly trained, careless or out-of-currency pilots have found the Navajo, like all light and medium piston twins, to be a wolf in sheep's clothing. It will bite the unprepared. But when all motors and systems are functioning, the Navajo series ranks up there with the absolute best-mannered Pipers ever in terms of handling.

CABIN COMFORT

Except for the tallest of pilots, the cockpit is comfortable. The Chieftain is the best of the breed in this respect, because it affords more legroom than comparably equipped and outfitted short Navajos. Visibility is quite good as conventional twins go. Even in the earliest versions, cockpit layout is good.

Passenger acceptance of the Navajo is excellent, according to owners and operators. Entry is eased with the airstair door and in the main cabin, all passengers are treated equally because of the uniform fuselage section and similar seats. The large windows add to a spacious impression.

All things considered, the Navajo offers a good environment for both pilots and passengers. Later models configured for corporate use are downright luxurious. In fact, the least comfortable seat in the house is the one near the main door, due to air noise and drafts.

SUPPORT, MAINTENANCE

The Navajo benefits from a fairly large population and a powerplant that continues in production, also in large numbers, thus representing a profitable support business. It is about as far from being an orphan as any out-of-production general aviation airplane could be. And with Piper back on its feet, support is no problem, although some owners complain about slow response from New Piper.

One owner supplied a list of favored suppliers and mentioned he had compiled a list of 60 maintenance and operational points that took some work to identify and to solve. Another mentioned "an aggressive preventive maintenance program which involves

It's the spacious interior, top, that partly makes a Navajo a comfortable charter aircraft. There's an airstair cabin door and in the Chieftain, an aft baggage door for loading up to 200 pounds of stuff, bottom photo.

magneto and alternator overhauls every 500 hours, replacement of the Airborne 400 series pneumatic pumps every 600 hours, fuel injector flow testing and cleaning every 100 hours, engine mount replacement every 400 hours, landing gear lubrication every 50 hours..."

Operating care is critical to engine and other system life. Temperature control, from start to shutdown, is an important element in care of the engines. Pre-heat, proper warmup and avoiding rapid throttle movement are simple yet critical factors in engine life. There have been a high number of cylinder problems, especially with the 350-HP engines used in the Chieftain (and the Colemill Panther conversions). Many of these have been attributed to operational causes, such as shock cooling in descent, abuse during training and generally poor technique in day-to-day operation.

In 1982, Lycoming issued a letter covering operational techniques aimed at improving service life. While it focuses on the Chieftain, the information is largely applicable to any turbocharged powerplant. Much of it concerns temperature management, but there are other useful recommendations, such as avoiding partial-throttle takeoffs to ensure proper fuel cooling and to avoid detonation. There also are additional maintenance and inspection tips in Lycoming's bulletin.

As GA airplanes go, the earlier Navajos are getting old. The usual effects of age are complicated by the fact that the FAA in 2002 added the Navajo series to its Aging Airplane Safety Rule, by dint of the model's use in airline service. The long-term impact of this rule is unknown but would-be buyers should know it could lead to expensive, required maintenance of various kinds.

Navajos have a large number of ADs associated with them, including more than their share of repetitive inspection requirements. Make sure that any airplane being considered for purchase is in compliance.

The design-specific (as opposed to accessory) ADs run from flight controls and flight control surfaces to structure and from landing gear to operational and handbook changes. Operational changes included limiting normal and maximum operating speeds at altitude and changes to Vmc for both the PA-31 and C/R.

One of the more notorious ADs limited use of the flaps to avoid strain and the potential for asymmetric flap deployment. It negatively affected the takeoff and landing performance of the airplane. This was addressed by factory and aftermarket changes to the flap transmission and other system improvements.

There are relatively few mods available for the Navajo. The best-known PA-31 mods originally came from Colemill Enterprises of Nashville, with its line of Panther conversions. These typically consist of a new or overhauled pair of TIO-540 engines, new four-blade Q-tip props and winglets. Colemill was taken over by Murfreesboro, Tennessee-based Mike Jones Aircraft Sales (www.mikejonesaircraft.com), which does the mods and offers the Lock and Key Navajo complete refurbishment program.

For a standard price of $895,000, you get a Navajo that's in like-new condition, including a $45,000 new interior and a $45,000 paint job, factory remanufactured engines with new dual-drive magnetos (or the choice of factory new engines for an additional cost), plus new four-blade Q-tip propellers. All accessories including turbochargers, wastegates and engine mounts are new, while redesigned engine cowlings allow for closing the cowl flaps during climb and picking up 15 knots in climb speed.

The advertised $105,000 radio package lists the discontinued

Garmin GNS530 and Sandel EFIS as standard. We contacted the company several times to learn more about the current offering of avionics and other accessories on the current Lock and Key package, but it never responded with an explanation.

American Aviation of Spokane, Washington (www.americanaviationinc.com or 800-432-0476) makes intercoolers, which should help out with engine problems by reducing thermal stress. Nayak Aviation Corp. (210-824-7511) sells auxiliary fuel tanks that increase capacity by a total of 52 or 54 gallons, depending on model.

OWNER FEEDBACK

I purchased a Navajo Chieftain with a partner with the intention of putting the aircraft on a 135 charter certificate, plus we planned to fly it for business and family travel. While this seemed like a good concept (we hoped the charter revenue would help cover our own operational costs), it didn't work quite as we expected.

Since the aircraft was once on a charter certificate, it was well-maintained, but still needed a sizable investment to bring it up to 135 standards and that of the Beech Baron 58 we owned for years. Our first project was an avionics upgrade, including ADS-B to meet the 2020 mandate. It had older BendixKing Silver Crown avionics, including a KFC200 autopilot that needed a lot of work to perform the way we expected it to. Two servo replacements, an attitude gyro replacement and nearly $8000 later, we had an autopilot that worked, but not great. When installing a Garmin GTN750, the shop found that the static system had numerous leaks requiring sizable troubleshooting and teardown to fix. But the real shocker was a failed weather radar that required a $10,000 repair. We opted to install Garmin's digital radar and ditch the traditional display in favor of the GTN750 as the primary display. But when the shop finished the installation, they determined the radome needed to be replaced. It was one thing after another.

We decided to fly the airplane for a few months to see how it performed before diving into the costly Part 135 certification process. Along the way we dealt with an air conditioning failure, a failed starter on the left engine, a gyro failure in the KCS55A HSI system, a broken cabin door that left my partner stuck inside when he was on a trip, plus a variety of other maintenance items that had us wondering why we ever sold our bulletproof Baron.

On the plus side, we enjoyed the large cabin and the aircraft's performance, although it wasn't quite as fast as our Baron. We ultimately sold the Navajo without putting it on a charter certificate because frankly, it was just too complex for our wallets. We ended up with another Baron and barely broke even after selling the Navajo, given the money we invested in one year of ownership. Luckily, the engines had low times since factory overhaul, which made the aircraft as attractive to the new buyer as it was for us. My advice to anyone considering a Navajo is to bring it to someone who knows these airplanes inside out for a prepurchase evaluation. It's just too complex to take a gamble.

Fred Massico
via email

I am the owner of Superior Airways, an air taxi charter business in Sioux Lookout, Ontario. We operate two Piper Chieftains and prior to Superior, I flew a Chieftain for several operators throughout northern Canada for over 1000 hours.

The aircraft can be reliable in the hands of a knowledgeable maintenance shop. There is much you can do to avoid common problems, but this entails spending money on overhauling components prior to their actual failure. The strongest point of a PA-31 is that they rarely, if ever, leave you completely stranded without many signs of impending problems. Understand, you may be temporarily restricted to daylight VFR ops to ferry the thing home, but it almost always starts and gets back.

The first issue I've had to deal with is the gear. Micro switches and both engine-driven hydraulic pumps must be replaced at their first signs of weakness. Raising the gear and waiting a longer than normal time for the gear lights to extinguish is your first clue. Intermittent gear horn warning beeps on the ground are another sign that a switch is starting to go. The

The Aviation Consumer

EQUIPMENT CODES

(continued from page 23)

For UAT systems installed along with Mode C or Mode S transponders, the codes are CU1 (Mode C transponder with UAT ADS-B Out), CU2 (Mode C with UAT ADS-B Out and In), SU1 (Mode S transponder with ADS-B Out) and SU2 (Mode S transponder with UAT ADS-B Out and In). Some combinations aren't possible—CB1, SB1 and EU1, for example.

PUTTING IT ALL TOGETHER

While you're gathering your data, you'll want to source the aircraft's hex code, aka the Mode S address, ICAO code, or 24-bit address by searching the tail number in the FAA's aircraft registry. In addition to figuring out the proper flight plan codes, it could be worth your while (and a timesaver) to learn how to use the flight plan filing utility in your navigation app of choice, if you don't already. ForeFlight has a section on its website on how to file ICAO flight plans in the app.

The FAA offers guidance at http://tinyurl.com/znvbo84, section 5-1-9 of the AIM is worth a read and AOPA's flight planner is a help.

The bottom line is it's time for aircraft operators, aircraft and avionics OEMs and avionics shops to familiarize themselves with ICAO equipment codes and document them in the aircraft's POH or permanent records.

Luca Bencini-Tibo is a lead FAASTeam rep, CFII and Mooney owner. For a code reference spreadsheet, contact him at luca_bencini@alum.mit.edu and mention ICAO Spreadsheet in the subject line.

PIPER NAVAJO

(continued from page 31)

power pack is also prone to failure after a certain amount of time.

The Lycoming IO-540s are strong, solid engines. Oil leaks are one persistent headache but are normally minor glitches. I've flown these engines throughout the high Arctic at -40 degrees C and have never experienced a cylinder cracking. It's just important to keep high power on descent and to reduce power no more than 1-inch MP per minute in descent, while trying to keep them as warm as possible. It's also important in the cold temperatures to run the right oil and block off part of the oil cooler to keep the temps up. Preheating is essential before starting for long service life.

Performance-wise, it is surprising how much TAS is related to takeoff weight. We run with the VG kit for a max takeoff weight of 7368 pounds. We see about 185 knots at 5500 pounds takeoff and 170 knots at gross. Fuel consumption runs at factory minimums of 30 GPH per side in the climb (giving about 1200 FPM at 130 knots) and can be reduced to 16 GPH a side in cruise. Oil consumption is minimal. Range with 182 gallons is about 800 NM with our second aircraft with the Nayak fuel tank option adding about another 200 NM.

The strengths of the aircraft are in the wide availability of aftermarket support and PMA spare parts available (usually). There are many operators with this type and therefore there is no shortage of experienced operators. With the right training and currency, they are easy airplanes to fly and will climb better than other light twins on one engine. The passengers also like them because of the bright, large windows, decent cabin size and fairly quiet ride. We operate both aircraft with noise canceling headsets for the passengers to ensure the quietest ride possible.

It's a shame that Piper decided to abandon this line of aircraft size, as they do 90 percent of what a Beech King Air 90 will do, for far less money. It's certainly easy to fly and will haul a large family fairly quickly along with a load of gear into fairly short, unimproved strips.

The downside is expect to pay about every bit of $400 per hour for direct operating costs and reserves, along with up-front fixed costs such as insurance, training, charts, etc.

Mike Misurka
via email

FEEDBACK WANTED

CESSNA 185

For the June 2017 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Cessna 185 Skywagon. We want to know what it's like to own these aircraft, 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. Send correspondence by May 1, 2017, to:

Aviation Consumer
Email at:
ConsumerEditor@hotmail.com