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EDITOR

Larry Anglisano

SENIOR EDITOR

Rick Durden

EDITORIAL DIRECTOR

Timothy Cole

EDITOR AT LARGE

Paul Bertorelli

SUBSCRIPTION DEPARTMENT

P.O. Box 8535

Big Sandy, TX 75755-8535

800-829-9081

www.aviationconsumer.com/cs**FOR CANADA**

Subscription Services

Box 7820 STN Main

London, ON SW1

Canada

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FIRST WORD**HONEYWELL GETS SERIOUS AT AIRVENTURE**

I always think of AirVenture as the last chance, final frontier when it comes to product marketing and this year my eyes were laser focused on Honeywell and its BendixKing division. Once the king of all avionics, BendixKing has been, as we say around the office, the lost ball in tall grass, with a history of unveiling prototypes of fresh products that ultimately end up stalled in a long certification process. The KI300 retrofit EFIS display unveiled several years ago, which is the proposed replacement for the ancient KI256 mechanical flight director, is only one example.

With little if any fanfare, BendixKing showed up at Sun n' Fun this past spring with the clean-sheet-design XVue Touch retrofit flight display, plus a certified version called the AeroVue Touch. We actually missed reporting on these products at Sun n' Fun because there were no press announcements that we saw.

But it was a different BendixKing that showed up at this year's AirVenture. The company put on an impressive media event, which included one-on-one time with the AeroVue Touch project manager Karan Shrivastava—a guy who knows the product inside out—and who knows how to tell the media and prospective buyers all about it. If you didn't see the system at AirVenture, it's legit. The 4K graphics quality of the AeroVue Touch display is impressive and the feature set is shallow, but logical and complete. It's also one of the first systems to use the Seattle Avionics Slingshot wireless nav data update technology. The built-in Slingshot tech curtails the database and chart update process by streaming the data into the display directly from a tablet computer. Look for a video tour on the *Aviation Consumer* YouTube channel and on our Facebook page. The company also showed up at AirVenture with STC approval for the multi-screen AeroVue integrated flight deck for the Beech B200 King Air, which I got to fly with in Honeywell's King Air test bed at the show.

As you can imagine, the AirVenture skies aren't the best place for demo flights, especially when looking at new avionics where your eyes are inside the airplane. But BendixKing, through its demo pilot Dan Johnson, did a good job staging (from a busy Basler Flight Service at Oshkosh) multiple IFR flights to a less congested Stevens Point Airport in Wisconsin in the King Air so a few of us in the press could see the system in action. The system, which trickles down from the Honeywell Apex suite used in the Pilatus PC12NG, was fully functional and did everything BendixKing said it's supposed to.

But the real attention getter was Honeywell's Boeing 757 test bed parked front and center in Boeing Plaza. As you see in the main photo above, it currently flies around a turboprop engine, and what you don't see, a bunch of new avionics that Honeywell is developing. I talked with Joe Duval, Honeywell's chief pilot, who said that Honeywell has no fewer than 15 R&D test aircraft, including the modified 757. This Boeing is the only aircraft in the Honeywell test fleet that has engine testing capability (for turboprop or turbofan engines). It underwent three years' worth of modifications to accommodate the third engine pod to support a variety of engines, and has an internal floor-to-ceiling fuselage frame to strengthen the airframe and support the extra load. The flying think tank is equipped with multiple workstations and dozens of computer networks. It's something to see and Honeywell was showing it off to a long line of showgoers.

I think Honeywell has the right idea by trickling down existing avionics technology from its business and transport jet market to GA applications. At the press briefing, the company said there are other projects forthcoming and it plans on expanding the King Air AeroVue STC to other applications, while an STC for the AeroVue Touch is imminent by the end of 2018. We'll see. —Larry Anglisano



FLIGHT DESIGN ON SAFETY

Paul Bertorelli's article on LSA accidents in the August 2018 *Aviation Consumer* was a fair and balanced look at the relative safety of S-LSA models compared to non-LSA ones in similar use. While this report separates nonsense from truth, I have several comments.

The time period used to examine the fleet safety was appropriate as it was the most recent, but by coincidence put Flight Design at a statistical disadvantage due to the fickle finger of fate. We went for a decade without a fatal accident in our then largest S-LSA fleet—something we never talked about publicly, as it was too precious and too fortunate to risk avarice by promoting the fact.

The fatal accidents we have had fall into two categories: typical accidents and rather unusual and unexplained ones. I have participated in almost every one of these NTSB investigations, gaining 30 years of experience with these airplanes, including a time when the company was manufacturing kits. The time period between 2014 and 2017 was rough for Flight Design and 2016 in particular was a witching hour for the whole S-LSA industry, with almost three times the statistical average of the years before and after. As was said, the fleet numbers, particularly by type, are so small that there is a lot of uncertainty in the ability to predict much from the raw data.

Regarding the overall accident rate: We have had more than our fair share of incidents and Paul's research and analysis is correct.

In our defense (which he mentioned), our planes were adopted as trainers early on and took the arrows of the learning curve of the sport plane business in the U.S. As a result of the early experience with the CTSW, Flight Design developed the CTLS to fit the needs of American pilots and flight schools. We had a good thing going with the Flight Design Flight Centers, with 24 operat-

ing at the height of LSA enthusiasm.

For all of the incidents listed, the injuries are very low. A carbon fiber egg is a good dwelling for occupant crashworthiness. From the leadership in Germany to the dealer level, we have tried to equip our planes with the most advanced safety equipment available.

A rigid carbon fiber cockpit, a standard BRS parachute system, the early use of electronic flight instruments, plus our attention to COSM (Continuous Operational Safety Monitoring) and participation in the ASTM F37 process. The list is long.

I've always said that it takes between five to 10 hours for a current pilot to properly transition to such an aerodynamically clean, low-mass aircraft. Many experienced pilots scoffed, telling me how many hours they had and what they've flown, but it's really much like a tailwheel transition. I know few pilots who'd hop into a Piper Pacer without transition training. For many Flight Design buyers, it's usually their first time with an integrated glass cockpit, operating a Rotax engine and also using a control stick.

After our discussion of this article, the new management of Flight Design general aviation are working on a plan to offer free transition training worldwide to all Flight Design owners, new or pre-owned, if done through an approved transition training instructor and done to our published syllabus requirement.

We will make it as convenient as possible to qualify those instructors consistent with the demonstrated ability through a short qualification process.

Last, early on our Florida dealer and current consultant John Hurst rang the alarm bell and created a Flight Design transition training syllabus, which we have strongly recommended pilots use to demonstrate competence, even after passing a checkride.



The training syllabus can be found at <https://tinyurl.com/ya6lcb9>.

Tom Peghiny
President, Flight Design USA

FINDING A MECHANIC

I am looking to buy a Piper Lance and am wondering what is the best way to find a reliable and knowledgeable mechanic to do a prepurchase inspection at some of the places that the planes are located. I was also wondering how much a pre-buy inspection should cost. I realize that there are a number of variables, but a ballpark number would allow me to plan for the purchase.

Wes Ballou
via email

If you're serious about this (or any aircraft) I would bring your own trusted mechanic, if you have one. It's generally worth the expense. The idea is to find a neutral third party who has no history with it or any interest—personally or professionally—in the sale. You'd be surprised how many do.

If that's not an option, look for a shop in the surrounding area and ask if they have any techs experienced with the model. A Lance is straightforward—nothing unusual about it.

As for cost, it's tough to say. Some buyers follow a basic annual inspection. For inspection only on that airplane, perhaps under \$2000, but get a labor quote first.

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AIRCRAFT FLIGHT TRIAL

Quest Kodiak Series II: A Workhorse Refined

With benign stall characteristics, excellent fit and finish and a high-end passenger cabin, the latest-gen Quest Kodiak isn't fast, but it's versatile.

Spend a short time with a Quest Kodiak 100 on the ramp and inevitably someone will call it a Cessna Caravan. Granted, they're both PT6A-powered high-wing haulers that stand tall and burly, plus they can both carry water floats and cargo pods. But look more closely (better yet, fly it) and it's obvious the Kodiak is unquestionably its own airplane.

BY LARRY ANGLISANO

The latest Kodiak 100 Series II has a change in personality from earlier versions, which in my view lacked some refinements that buyers expect in an airplane that's north of \$2 million, and closer to \$3 million when equipped with the Aerocet two-piece carbon fiber amphib floats. That's the configuration I spent a day flying off the pavement and the water for this report.

CLEAN SHEET, MODERN BUSH
Sandpoint, Idaho-based Quest Air-

craft says the Kodiak came to life (during the late 1990s) to fill the need for a modern-day bush airplane. Initially sketched on the back of a napkin by its two company founders, the Kodiak's first flight was in 2004 and it earned FAA Part 23 type certification in 2007, 32 months after its first flight.

A clean-sheet design with STOL capability, the Kodiak initially catered to humanitarian groups that needed to get in and out of tight and unimproved strips. It carries a sizable payload (upward of 3500 pounds and roughly 2500 with floats), seats up to 10 people and most important, it runs on Jet-A for operating in places where 100LL is impossible to get, and of course to up the ante in reliability and operating simplicity. Quest chose the 750-HP Pratt & Whitney PT6A-34. It has a 4000-hour TBO—which at the time was the most widely produced single-stage variant of the PT6A—making worldwide field support even easier.

CHECKLIST



The Series II Kodiak has the much-needed refinements that previous models lacked.



The Aerocet 6650 amphibious floats are efficient and forgiving.



On wheels the Kodiak may be the slowest turboprop single, but it gives plenty back in utility.

A talking point during prospective Kodiak 100 sales demos is the -34's lower overhaul cost, compared to other variants. But make no mistake, overhauling any PT6A is a major event. The current *Aircraft Bluebook* says a typical overhaul including installation is around \$240,000. Check that against the Pratt -114A variant used on the Cessna 208 Caravan. A typical overhaul for it is around \$250,000 and the TBO is shorter, at 3600 hours.

The Kodiak's engine is tuned to operate at lower altitudes and optimized for ops in the 12,000-foot range, where the unpressurized, fixed-gear airplane spends most of its time. Its certified max operating ceiling is 25,000 feet.

The Aerocet 6650 carbon fiber floats on the Kodiak 100 in the lead photo are a superb match for the rugged airframe. They're a \$399,000 option for the Series II model.

The Kodiak has a wet-wing design with a 320-gallon fuel capacity, and there's now an STC'd single-point fueling option, located at the left wing root. All of that fuel is stored behind the main spar, creating a fire-resistant crumple zone in front of the occupants. There's also a clever magnetic under-wing fuel measuring dipstick, which makes verifying the fuel status—and cross-checking the Garmin G1000 NXi's digital computations—a snap.

OODLES OF STORAGE AND A UNIQUE WING

The Kodiak has a big 49 by 49 inch cargo door that was designed for loading pallets. The door folds down flat for easy forklift access, plus it functions as an air stair for loading the passengers. The cabin is 48.5 inches wide and nearly 50 inches high. That's not a stand-up cabin, but it's spacious, especially when equipped with the executive interior. The cargo volume is listed as 248 cubic feet and there are cabin doors (one on each side) for climbing into the cockpit.

For more utility, on wheeled versions there's an optional composite external cargo compartment (ECC), which has a maximum load-carrying weight of 750 pounds and a max floor loading of 65 pounds per square foot, enabling a variety of loading scenarios. The ECC is divided into three compartments with internal anti-skid flooring (each with an individual door), and each compartment is separated by composite bulkheads. While the ECC looks like it might rob a sizable amount of performance, the airplane only loses a couple of knots in cruise thanks to its aerodynamic design.

There's also a 29-inch tire upgrade for better handling and durability when operating off unimproved strips. This increases the aircraft's landing weight to 7225 pounds. The fixed Cleveland landing gear is of a faired leg design with no wheel pants. The mains are spring steel and the steel nosegear is air-Oleo.

There's a gravel/mud deflector that attaches to the gear to minimize the slinging of rocks and other debris onto the bottom of the wings, fuselage and horizontal stabilizer.

What makes the Kodiak different than most other turboprop singles



One of the Series II upgrades is a three-screen Garmin G1000 NXi, top. The dual-zone digital climate control system, middle, is a welcomed creature comfort and complements the Kodiak's executive interior, bottom.



is the wing design, which marries two wings into one. There's a notch in the wing's leading edge, which Quest calls the discontinuous leading edge. That's the area of the wing that doesn't stall. Pull the power lever back to zero thrust, haul back on the yoke and the outboard section of the wing doesn't stall. That means full aileron control and no change in roll rate in a stall—it's pretty remarkable.

New to the Series II Kodiak, in addition to the three-screen Garmin G1000 NXi (an upgrade from the plain-vanilla G1000 used in previous models), is Safe Flight Instrument's angle of attack indicator. The system uses an indexer that mounts on top of the glareshield and has audible and visual cues. Stall speed

with the single-slotted Fowler flaps up is 77 knots and 60 knots with the flaps down.

The airplane I flew had the optional TKS ice protection system installed, but it's disabled when the floats are installed. The system has a 16-gallon de-ice fluid tank for 2.5 hours of continuous operation in normal icing conditions. The system makes the airplane approved for flight into known icing.

Standard, of course, is mandate-compliant ADS-B Out via Garmin's



On the ramp or on the water, an amphib-equipped Kodiak 100 is a big airplane, but the 750-HP PT6A gets it off either surface with good authority. The Aerocet amphibious floats have hydraulic landing gear. The gear lever is somewhat of a reach, positioned between the two front seats, bottom photo.



clutter suppression—which identifies and removes ground returns from the display.

MODERN FLOATS

The Kodiak 100 I flew was the first one fitted with the Aerocet model 6650 two-piece carbon composite amphibious floats. The Aerocets weigh a touch over 1200 pounds (maximum flotation is 7406 pounds) and come standard with a gear advisory system with audible announcement for gear positions and “check gear” warning callouts.

There’s an annunciator that shows when the hydraulic pump is running and the digital control head shows the status for each gear wheel and its position.

There’s also built-in hydraulic overpressure relief, while the reservoir and sight glass are built into the hydraulic power pack so you can get a quick

read on the fluid levels.

The floats have nine watertight compartments and six storage lockers with large access doors and high-end hardware that makes it easy to tell when the doors are secured. The floats have molded steps for climbing aboard.

Quest Aircraft’s Mark Brown told me the floats are impressively watertight, and that’s partly because there are no rivets. “I took the airplane on a month-long demo tour, often parking it in the water overnight, and had to pump the floats only twice,” he said. The two-piece molded composite construction also means no corrosion.

A big advantage of the Aerocet 6650s, which are the largest and only composite floats on the market, is the weight savings. They are 400 pounds lighter than equivalent metal floats, saving weight for more people and fuel.

But modern design and efficiency comes at a price. The Aerocet 6650s add an eye-watering \$399,000 to the cost of the Kodiak 100, including the installation hardware. Kodiak also offers the Aerocet 6750 straight floats.

FLYING IT

The Kodiak 100 has a maximum take-off weight of 7255 pounds and with the Aerocet floats installed, it’s a big aircraft to operate around the airport surface. For water ops, there’s an option for a pitch latch propeller. This allows the propeller to stay in a fine-pitch position when the engine is shut down. When you start it, this takes less time to get the airplane away from the dock and taxiing on the water.

A wheeled Kodiak has a 934-foot takeoff ground roll and a published 1340 FPM climb rate. Typical climb speed is around 88 knots. On floats with a strong headwind, 500 pounds of fuel and four average-sized adults on board, we were off the runway at Windham Airport in Eastern Connecticut and into the climb in well under 1000 feet.

Since the PT6A engine isn’t FADEC controlled, you do have to be especially mindful when setting the power and vigilant in not overtorquing it—a pricey blunder that requires an engine teardown. But, the engine actually has up to 900 HP available should you get yourself into trouble on the water or on land and push the power lever to the firewall, which would overtorque

integrated 1090ES transponder. There’s also active traffic and terrain alerting, and new to the Series II is the GWX70 weather radar. The standard GWX70 version has four-color storm cell tracking and side-view vertical scanning to profile cell buildups and storm tops. As an option via an enablement card, there’s turbulence detection and ground

and over-temp the engine.

As for performance, you'll sacrifice roughly 20 knots of cruise speed and a couple hundred FPM of climb with the Aerocet floats. The book says maximum cruise performance on wheels is 183 knots. At a 174-knot cruise speed in no-wind conditions, a Kodiak without floats or a cargo pod has a range of 1005 nautical miles with 45 minutes of reserve fuel at 12,000 feet.

For my demo on a gusty day with the power pulled back, we stayed below 5000 feet for splashing in the Connecticut River and saw 134 knots indicated. But for going places, you'd likely climb up to 10,000 or 12,000 feet, where the Kodiak would clip along at 160 knots true—hardly shabby for anything carrying big floats. Expect to burn around 350 PPH (58 GPH) of Jet-A.

Contemplating my first water landing in the Kodiak (with whitecaps visible in the river), I asked Brown about the typical transition experience for competent seaplane pilots coming out of smaller piston-powered aircraft. According to him, transitioning to a Kodiak 100 on floats is quite different because it's a turboprop. He's right.

Having earned my seaplane rating in a Cub on floats, but having logged time behind a PT6A, it took some time to get over the Kodiak's size. It stands real tall on the Aerocets and like flying any large airplane for the first time, judging when the floats will touch the surface was tricky. Moreover, the long snout can pose some challenges on the water. For example, in a piston seaplane you can generally nose into a dock, but that might not be an option in the Kodiak. And, when you shut down the engine when approaching the dock in the Kodiak, the prop will windmill. It stops right away in a piston, of course.

But saying all that, the big Aerocets are quite forgiving when touching down—and going around—because of their large sweet spot. With Brown calling out power settings (while his hands hovered centimeters from the controls), I was getting the hang of putting the Kodiak on the rough water. In jet airplane fashion, I especially like that the automatic trim runs after



you deploy the flaps, even when the autopilot isn't engaged.

The floats are slippery in the sense that you hardly feel abrupt acceleration when the aircraft leaves the water. I was also impressed at how quickly the floats got onto the step. For tightly confined water ops, it's real easy to get used to 750 HP, as long as you're aware of the turbine spool lag.

Back on pavement, the Aerocet's trailing link main gear with Oleo shock system makes for smooth touchdowns. The advertised landing ground roll is 765 feet and yes, pull the prop into reverse Beta to get the airplane stopped quickly.

TESTING A NEW MARKET

With excellent fit and finish, the Series II Kodiak 100 is a different airplane than it was in earlier generations thanks in part to a more refined and sophisticated cabin dwelling. There's more soundproofing and also inflatable door seals that make it quieter, plus you don't smell the jet exhaust that makes its way into the cabin as you do in earlier models.

The cabin has good lighting with high-end fixtures, comfortable seats and modern amenities (USB ports, for example) that every buyer is likely to expect. The Series II is equipped with Garmin's Flight Stream wireless hub for tablet connectivity.



On wheels, the Kodiak 100 easily carries an optional external baggage compartment/cargo pod with a 750-pound max loading capacity. It's easy to access the PT6A, top photo, for preflight chores.

Clay Lacy Aviation, Quest's Northeast dealership, is trying something interesting with Kodiaks by adding them to its charter ops to complement its fleet of 100-plus jets. For jet setters who want transportation to or from New York City's East River to the Hamptons, as one example, a Kodiak on floats is up to the task. Quest is also adding to its network of domestic and international dealers to support the Series II and the 200-plus aircraft in service.

The new Kodiak 100 starts at \$2.15 million and nearly \$2.8 million with floats and popular options. Visit www.questaircraft.com.

You Tube See a video review of the Quest Kodiak at <http://tinyurl.com/j95ht2a>



Avidyne IFD550: GPS Nav With Attitude

With wireless streaming and built-in SynVis, Avidyne's flagship IFD550 navigator offers sizable redundancy and a mostly slide-and-fly installation.

by Larry Anglisano

Since the release a few years ago, Avidyne has earned considerable industry respect for its IFD-series retrofit navigators simply by doing what buyers expect. It has incrementally advanced the interface by adding clever features and utility, while being mindful of third-party compatibility. It also curtails the installation effort with a plug-and-play interface with Garmin's legacy GNS-series WAAS navigators.

AVIONICS FLIGHT TEST

While the flagship IFD550 navigator can easily drop into an existing GNS530W installation (or be wired from scratch), that's about the only thing it has in common with Garmin's old interface.

With built-in wireless connectivity, a dedicated tablet app, impressive display quality and onscreen flight instrumentation—including synthetic vision and TAWS terrain—the

IFD550 packs a strong punch for its \$21,999 retail price.

We recently spent a day flying with the IFD550 in Avidyne's Cessna 206 to sample the interface and prepared this field report. Up front, this is a deep interface, so we'll focus on major features, functionality and the UI.

WIRELESS CONNECTIVITY

Avidyne engineered the smaller-screen IFD440 navigator (still in the product line and sharing a lot of the IFD550's feature set) with both Bluetooth and Wi-Fi—tech spills into the IFD550. There are no external hubs to wire in because the wireless transceivers are built inside the navigator.

Aside from connecting to an iPad running the IFD100 app, which adds a second IFD550 display/control set, the navigator connects to a Bluetooth keypad as another option for data entry. It's standard on every IFD model and adds to the choices of how you

CHECKLIST

-  Built-in attitude reference sensor gives the IFD550 primary flight display utility.
-  Mostly a plug-and-play install for the Garmin GNS530W navigator.
-  An iPad and the wireless keyboard make for a highly customizable user interface.

interact with the navigator. There's the native hybrid touch, knobs and keys, plus you can interact with the navigator from the iPad and remote keyboard. It really caters to a wide variety of users

What differentiates the IFD550 from the IFD540 is the IFD550's ARS, or attitude reference system. Other than accepting a heading input from Aspen's Evolution PFD, in addition to Garmin's G500/600 PFD, the Avidyne ARS is self-contained. The navigator also sends GPS nav and course data into the displays over an ARINC 429 data stream. For dual installations (maybe an IFD550 and IFD440), the connections are independent for redundancy, but have full synchronization.

If you don't have an Aspen or Garmin PFD for the air/data interface, it's compatible with Shadin's air data computer. The IFD550 also comes standard with forward looking terrain alerting, or FLTA, plus SynVis and Jeppesen approach charts.

No, the IFD550 isn't as big as Garmin's flagship touch-only navigator, the GTN750. Remember, the IFD550 and also the 540 are intended as drop-in replacements for the GNS530W (and first-gen non-WAAS GNS530 after an antenna swap).

The unit has is a 5.7-inch VGA

We shot the lead photo of the Avidyne IFD550 while on the RNAV approach to Runway 33 at Worcester Regional Airport in Massachusetts. It has syn vis, but not airspeed and altitude tapes because it isn't certified to display them yet.

AVIDYNE IFD550 CONTROL SET



Bluetooth keyboard
(approx. 2.5 by 3.5 by 0.3 inches)



screen with a 640 by 480 pixel count. Check that against Garmin's GTN750, which has a 6.9-inch display with a 600 by 708 pixel count. Both systems have 65,535 colors. As for chassis size, the IFD550 is 4.6 inches high, compared to 6 inches on the GTN750.

The installation we flew with had an IFD550, IFD440 and an Aspen Evolution, used for air/data and magnetic heading input. It also had an iPad running Avidyne's IFD100 app.

To show how focused Avidyne was in executing the wireless potential of the IFD, it developed a workaround for using popular portable ADS-B receivers like the Appareo Stratus in the interface.

For example, since the Stratus is designed to be the wireless access point rather than a wireless client, Avidyne enables users to switch the IFD's Wi-Fi to client mode. That allows the simultaneous use of the Stratus, Avidyne's IFD100 app and

the ForeFlight app (there are others, including FlyQ) on the same iPad.

MULTI-TOUCH FLIGHT PLANNING IN ACTION

Avidyne was the first with a hybrid multi-touch feature. In fact, it paid close attention to how potential buyers naturally tried to interact with the earlier MFD displays (which didn't have touch interface).

"After the Apple iPhone came out, we were showing the product at trade shows and clearly saw that people were getting used to multi-touch feature sets, which is how we designed the IFD from the start," Avidyne's CEO Dan Schwinn told us on our demo flight. True story.

We found ourselves using the IFD550 (and smaller IFD440) the way Avidyne expects, which is with a combination of the capacitive touch and the bezel buttons. For example, for comm radio frequency changes our instinct is to dial in the numbers

old-school with the frequency knob and the IFD (like Garmin's touch navigator) allows it. A nice touch is the textual station identifier for the active comm frequency. It's shown below the channel readout in the comm window. Another way to tune is to touch the active or standby frequency slot and when the virtual keyboard is displayed, type the frequency into the numeric keypad and then press Enter.

For zooming and scrolling the map, for example, you'll of course use touch gestures. It's the best of both worlds, in our view.

If interacting with the IFD550 through the Bluetooth wireless keyboard is your preference, a healthy number of functions (not all) are available with it. We found it most useful for building flight plans.

We constructed and entered a flight plan on the fly using the keyboard, adding the Gardner VOR as one of the waypoints in the flight



That's the Bluetooth QWERTY keyboard, top, which has built-in volume controls and nearly endless battery life. You can also program with the IFD550's onscreen keyboard (that's the IFD540 pictured in the middle), or with the IFD100 iPad app, bottom, which has two-way communication with all of the IFD navigators.



IFD is programmed to control Avidyne's remote transponder, then the transponder tuning is added to the mix.

HARD KEYS AND DATA DISPLAY

While the IFD550 can replace a Garmin GNS530, don't expect a Garmin feature set. Avidyne has long adopted its own operating logic, starting with unique user controls. Here's an abbreviated tour, in addition to the pictorial on page 9.

The four buttons along the bottom of the IFD550 bezel (three for the IFD540, which doesn't have synthetic vision) are called page function keys and have a left/right rocker action. There's SVS (synthetic vision), FMS (flight management system), MAP (moving map display) and AUX (for accessing the system page for setup and other user functions).

Select the main page you want by pressing in the middle of the rocker and navigate through the available onscreen tabs by pressing the left or right side of the rocker.

The line select keys are the buttons on the left vertical side of the bezel. They differ from the page function keys in that they have an onscreen

label just adjacent to the physical key, which indicates the key's function. Pressing the corresponding key or touching the label on the screen either performs the labeled action or changes its disposition. The bottom right rotary knob is a modal knob, in that its function is context dependent and is soft-labeled on the display. In general, both the inner and outer rings of the dual concentric knob perform the same function. As the pilot guide explains, think of the inner ring as a "fine" control and the outer ring as a "coarse" control of that specific function. You can identify it onscreen by a ring with center dot.

Like the other IFD navigators, the IFD550 has configurable data strips along the sides of the display. There's also a top strip datablock. These can be turned on or off, depending on how tolerant you are of a busy screen. In our view, it can get pretty busy given the amount of data that can be displayed. But the IFD100 tablet app solves a lot of that problem, essentially functioning as a secondary screen (or a third in dual-IFD installations).

INTERNAL ARS

The IFD550 has an internal attitude reference sensor or ARS, displaying pitch and roll data directly on the screen. This sensor has full TSO certification, but the displayed data isn't considered a legal backup.

The IFD550 won't display airspeed or altitude (just pitch, roll and slip/skid data), although when the navigator is connected to an air data computer (including the Aspen or Garmin PFD), airspeed and altitude data passes through the IFD550 and is sent via Wi-Fi for display on the IFD100 tablet app. If the IFD550 is receiving heading input from an approved source, there's onscreen heading and rate of turn.

In the airplane we flew, the pitch and roll data served as a third source of crosscheck when you count the primary Aspen PFD data and the backup attitude gyro. As Avidyne's Schwinn put it, "Should there be a difference in displayed attitude between the primary and backup attitude sources, pushing the SVS button on the IFD550 offers another opinion when deciding which source you want to trust as accurate."

plan, while the navigator (via the Geofill feature) automatically called it up because it was the closest to our current position. Geofill also works for tuning navaid frequencies. Type the identifier for the desired frequency and Geofill calls up the most likely navaid station based on your position.

Last, you can touch the Freq button along the right edge of the bezel, which presents a list of likely frequencies. Scroll through them via touch or with the right-hand knob.

You toggle between comm and nav frequency tuning by pushing the lower left knob, which times out after 20 seconds of inactivity. If the

SYNTHETIC VISION

The IFD550's SynVis function (overlaid directly on the IFD display) uses GPS-based MSL altitude and a 9-arc-per-second terrain database to display a 3D egocentric out-the-window view. There's a total velocity vector/flight path marker that indicates where the aircraft is going, plus the yellow triangular aircraft reference symbol that indicates where the aircraft is pointing. The display also shows airport flags, 3D traffic, terrain and obstacles, plus large bodies of water. If you used synthetic vision on a PFD or on a tablet app, the Avidyne's SynVis should be familiar.

We like that the SynVis field of view can be adjusted by either pinch-zoom gestures on the IFD550's touchscreen or by twisting either ring of the bottom right bezel. You can quickly restore to the default 45-degree field of view by pushing the bottom right bezel knob. You have the option of turning the SynVis off and displaying a traditional blue/brown attitude indicator or turning off all the flight data.

When the navigator is programmed with an active flight plan, the active leg is displayed onscreen in magenta and the next leg in the flight plan is depicted in an alternating (dashed) magenta and white line. We like that you can preview approaches, SIDs and STARs before adding them to an active flight plan.

As for 3D traffic (from an active TAS processor or an ADS-B system) the SynVis function depicts targets using the same symbology as it does in the navigator's thumbnail traffic view. However, the SynVis presentation helps to identify the relative threat of the traffic by altering the size of the onscreen target. In other words, as the traffic target draws nearer to your own position, it grows in size in the SynVis scene. Targets outside of 10 nautical miles aren't displayed, unless they become a proximity or traffic alert.

Worth mentioning is that in addition to attitude data, the IFD550 displays lateral and vertical approach guidance directly on its screen. This means if the primary flight display screen fails, you can still fly the approach by putting your eyeballs on the IFD550. It might not make for the most efficient scan, but it can work.

Speaking of approach guidance, the IFD has simple but useful audible alerting. Intercepting the GPS



Avidyne has earned an STC for retrofitting the IFD550/540 in Cessna CitationJet models (525/525A) that have Collins Pro Line 21, top photo. Also appropriate for jets is the GPS-only IFD545 shown at the bottom. Notice the missing radio knobs.



glideslope to Worcester Regional's Runway 33, an audible ding-dong alerted us we were about to begin descending on the autopilot coupled approach. Be sure to ask your installer if the installation includes the audio interface because it requires additional wiring. We think the install is shortchanged without it.

VERSUS GARMIN

We can only scratch the surface of the IFD550's feature set in a single article and for certain, owners of existing ancient Garmin GNS530 navigators get a sizable jump in capability, performance and technology. But that's also true of the Garmin GTN750, the IFD550's nearest competitor, which requires a wiring change. Adapting to either box might be challenging and our advice is to use each before buying one and try the tablet-based simulators. Avidyne and Garmin both offer training.

Pricing is tricky when putting the IFD550 nose-to-nose with the GTN750. The list price of the IFD550

is \$21,999 and the GTN750 is \$16,000. But, Flight Stream Wi-Fi capability is an extra \$1499 on the Garmin, and standard on the Avidyne. If you care that the electronic charts (and 6000 taxi diagrams) are Jeppesen-based and not NOAA charts, it's an additional \$1995 on the Garmin, but standard on the Avidyne, as is forward looking terrain with TAWS. That's a whopping \$7995 extra on the Garmin and required in many turbine applications.

Like the rest of the IFD navigators, the IFD550 is an approved WAAS position source for connecting to ADS-B Out equipment. It displays ADS-B weather and traffic data from the L3 Lynx, the GTX345 and from Avidyne's Skytrax 100. The GDL69-series SXM receiver is also compatible.

To sum it up, we think the IFD550 is a credible alternative to the GTN750, with a rich user interface that's more customizable thanks to hybrid touch and a remote keyboard.

Visit www.avidyne.com.

Intercooling 101: Detonation Defense

Intercoolers have been offered by OEMs and for field retrofit for years, but there are technical tradeoffs that don't make them an across-the-board winner.

by Paul Millner

Based on calls and letters we've fielded, there's a certain mystery that surrounds engine intercooling systems. But there's no mystery because simply put, an intercooler is essentially a radiator, or heat exchanger. That's the key to engine longevity, of course.

But aftermarket intercooling systems add complexity and can crowd already tight engine bays on turbocharged aircraft. For engines that have efficient turbos, an intercooler might not do much. For others—especially those plagued with high cylinder head and turbine inlet temperatures—the investment could be worth it. Here's a deep technical analysis to help with the decision, and some tips for assessing a given design.

IT'S ABOUT LOWER TEMPS

An intercooler's goal is fairly simple: Reduce induction air temperature. If you had a simple Ideal Gas Law $PV=nRT$ compressor, the simple fact of compressing gas (in this case, ambient air) from, say, 10 PSIA and 23 F (at roughly 10,000 feet) back to sea level pressure of 14.7 PSIG would heat the gas. But, in addition to that ideal gas behavior, our turbocharger compressors have other inefficiencies, like internal recirculation and heat transfer from the cowling environment, that heat the gas further. It's not uncommon to see compressor discharge temperatures (CDT) over 200 degrees F at middle altitudes and over 300 F in the flight levels.

Now, having compressed air is a good thing; it allows the packing of more fuel/air mixture into the cylinder on each combustion event cycle, thereby allowing delivery of more horsepower to the propeller. However, there are downsides.

The associated elevated air temperature can cause wear or deterioration of induction system components (turbocharged through-the-carburetor engines commonly have a 240-degree redline on CDT to avoid cooking the carburetor's seals).

But more importantly, elevated induction temperature increases the detonation tendency of the fuel. Cessna's Cesar Gonzalez estimates (in various ASTM papers) that increasing induction air temperature (IAT) by 10 degrees increases the fuel octane requirement by one octane number. Or, in FAA speak, increasing IAT decreases the regulatory required detonation margin offered by the certification-required 10 percent higher-than-demonstrated-no-problem fuel flow.

EFFICIENCY AND DETONATION

Let's step back and look at the goal of an internal combustion (IC) engine. Converting chemical energy into mechanical energy is a fairly inefficient process, but IC engines are better than the steam engines of yore. And the higher the compression ratio of the engine, the more efficient the energy conversion. So why don't gasoline piston engines have 20:1 compression ratios like diesel engines do? Because of destructive detonation.

As you compress and heat the gasoline/air mixture, the temperature rises, and increased temperature increases the rate of almost all chemi-

That's a Tornado Alley turbonor-malized modded Cessna Cardinal RG in the main photo. The red arrow points to the intercooler mounted vertically on the firewall.



cal reactions. Detonation occurs when the air/fuel mixture is ignited and the flame front begins burning across the mixture in the cylinder, increasing its pressure. As that flame progresses, the “end gas” (the portion of the air/fuel mixture that hasn’t combusted yet) gets compressed and heated more and more by both the combustion pressure wave and by the infrared heat radiation from the ongoing combustion, moving at the speed of light into the end gas.

For every fuel and fuel/air ratio, there’s a critical temperature/pressure at which combustion ceases and detonation begins: combustion moving faster than the speed of sound, creating a sonic boom shock wave. Making the incoming air hotter moves the entire process closer to that critical temperature/pressure point.

Detonation can have a couple of negative effects. Light to moderate detonation is actually fairly well tolerated by most aircraft engines and isn’t that uncommon. The DC-7 and Lockheed Constellation routinely completed long overwater flights with all four engines operating in light detonation. But there’s a limit.

Severe or extreme detonation can quickly lead to engine destruction directly, or by launching preignition, which can destroy an engine in seconds. The destructive mechanisms are temperature and pressure: As the combustion moves from moderate to severe detonation, the pressure pulses inside the cylinder disrupt the boundary of stagnant gas along the internal surfaces of the cylinder head. This greatly increases heat transfer from the ongoing combustion to the cylinder head.

At the same time, the detonation causes these temperatures to rise. During significant detonation, CHTs that begin in the 300-degree range may increase by one degree F every couple of seconds, something that has been observed and documented. If not arrested by engine control inputs, the cylinder head temperature will rise so high that the aluminum alloy of the piston will deteriorate. This can directly lead to gas leakage at the edge of the piston.

In addition, over time the high peak pressure pulses associated with the moderate to severe detonation can cause the top ring to crack. That,

too, causes large leaks of hot exhaust gas down the side of the piston. While the cylinder heads or assemblies rarely fail, the pistons and rings do fail as a result of detonation. If the detonation persists long enough, with say, high moderate to low severe detonation, objects in the cylinder environment get heated hotter and hotter and some items—maybe a part of a spark plug ceramic (which can crack due to the detonation) or the tang of a helicoil—will start to glow red hot. Once the glowing part gets hot enough, preignition begins, and the CHT can rise several degrees per second (as opposed to several seconds per degree with detonation). This gets the cylinder to “come from together” time very quickly, maybe more quickly than some pilots can notice, analyze and react to. So, these overheating and destruction processes are good to avoid; at the same time getting more boost to the engine is a good thing. So, since detonation tendency is correlated with IAT, let’s simply lower the IAT through intercooling, right? It’s not that simple.

The intercooler imposes a flow restriction on the induction system, causing a pressure drop across the flow resistance of the intercooler. That’s OK; the turbocharger typically has a control system on it, so to achieve the design point induction pressure, the wastegate will close a little, and the turbo will work a little harder to overcome the insertion pressure drop of the intercooler. So now we’re back to the same induction air pressure as before, but at a new, cooler temperature. The cooler air is denser, so at the same induction air *pressure* more oxygen is available, so more fuel can be added,

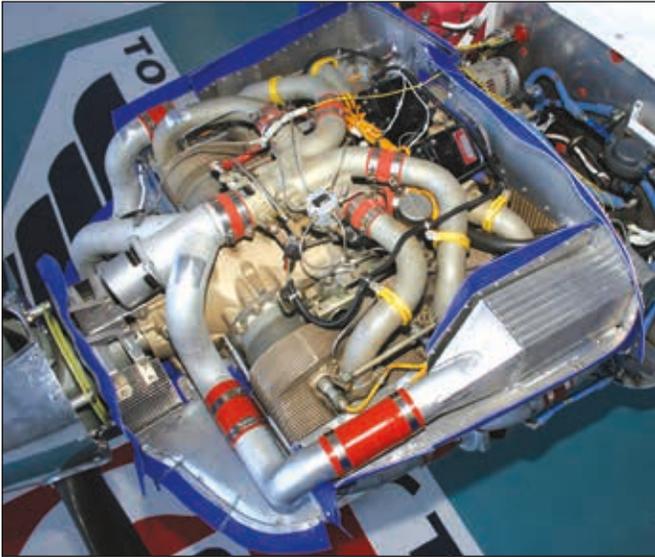


That’s an OEM intercooler on a Cessna P210, top. As you can see in the lower photo, an intercooler is essentially a radiator.

and more power delivered. Sounds great, right? But, the FAA and others get concerned.

That’s because now you’re asking the engine to deliver more power than it was certified for, so although you’ve increased the detonation margin by cooling the induction air, these naysayers want you to also reduce the induction air pressure to keep total oxygen available constant, before and after intercooler installation, and hence keep power constant.

Unfortunately for pilots using these systems, and to the discredit of the system manufacturers and certifiers, that’s not how the real world works. If you actually put a turbocharged engine on a test stand and then observe the effect of the intercooler, you’d find that, say, 32 inches of MP and 200 degrees of induction air input deliver almost the identical horsepower as 32 inches of MP and



Tornado Alley Turbo increases detonation margins on its turbo-normalized IO-550 used in the Cirrus SR22 TN, top photo, with monstrous intercooling.

otherwise, IAT limits might cause you to run further away from peak (either richer or leaner) to protect the engine and reduce power output.

First consider the location for the intercooler. It needs an uncomplicated-as-possible path between the turbo discharge and the induction system intake. And it needs ready access to cooling airflow that doesn't overly complicate overall engine cooling. And it would be best if there's nothing nearby, like exhaust risers or cabin heat dump valves, that will actually HEAT the intercooler, turning it at least partially into an interheater instead of intercooler. Finally, the location needs to offer a decent mount system to resist cracking of both the intercooler and the attachment points from engine vibration. Second, it's critical to synthesize the induction air path. On some aircraft that's easy; on others, Rube Goldberg would be challenged. Third is that good cooling airflow is a must, but without compromising engine cooling.

On that design note, over the years most intercoolers have been derived from General Motor's Harrison Division designs. And conveniently for aircraft designers and modifiers, GM Harrison provides a design guidebook. But, it's a potential trap. Cooling airflow for trucks (the primary Harrison intercooler market) and automobiles is very different than cooling airflow for aircraft. Due to the much higher speed of aircraft, higher "upper plenum" pressures are available. But, due to cooling drag concerns, volumes of cooling air are limited, at least if one wants to avoid slowing down the airplane. As such, as tempting as it is to use the correlations and design notes offered in the Harrison guidebook, and that is still

120 degrees of induction air.

So unlike obeying the restriction of the STC and reducing manifold pressure so many inches per 10 degrees of cooling, leaving the manifold setting alone delivers the same power, with safer-for-the-engine conditions. How?

Remember when I explained how the intercooler imposes an insertion loss on induction air pressure, but no worries, the turbo control system will compensate? There are no free lunches. It turns out that the additional back pressure on the engine exhaust from the wastegate closing just a little bit to maintain induction pressure through the intercooler reduces engine power output just enough to offset the increase that would otherwise occur from the denser charge. It may not be obvious why such a conservation-of-engine-output effect would occur, but for efficient intercoolers, that's the relationship.

Of course, some installations are markedly inefficient, and insertion of the intercooler imposes excessive induction pressure losses, and the turbo compensation for that actually reduces total power output. But, reducing allowable manifold pressure makes that even worse, which isn't a solution. In my view, it just suggests that mod developers need to be even more circumspect and analytical than they have been historically.

INSTALLATION FACTORS

Now that you've got a deeper understanding of how intercooling works, maybe you want an intercooler to allow you to maintain relatively high engine output even on hot days when,

a good place to start, one must think carefully about what's different in an aircraft installation, and what our overall goals are in cooling system design. One can argue that this hasn't often been done well. Last, the system has to be maintenance-friendly.

Achieving simple design beauty isn't always possible; my own plane, a turbo Cardinal RG boasting the Cardinal Cruiser III configuration by Tornado Alley, posed a significant design challenge. There was a great place for the intercooler on the pilot's side firewall, far from the exhaust system. The cabin heat dump valve could be deflected. Cooling air is readily available from the top of the engine and the exit path is short and clear via the cowl flaps. But, the induction plumbing!

The original Cardinal Cruiser I design had only a 3-inch hose between the turbo discharge and the fuel injection servo air inlet. But, to get the intercooler in on the act requires over six feet of induction plumbing. It's a credit to Tornado Alley's engineering department that the entral is so nicely designed, routed and supported, while avoiding significant pressure drop. It requires changing from the larger Bendix mags to the smaller (and in the process, pressurized) Slick mags to make room for the plumbing and my mechanic impugns my Hungarian ancestors every time he has to adjust the governor's prop control rigging. But overall, it's fairly elegant, for being a snake in a briefcase.

This paying attention to details is the core of turbo system design. Recall that in the early days Cirrus decided to design its own turbo system. At the time (around 2007), Dale Klapmeier told *Aviation Consumer* that after flying the system in-house it determined the system was a good performer (although not without cooling issues) and surely recognized the benefits of turbocharging, but it dropped it because of the uncertainty in 100-octane fuel. It dropped the project and bought the entire pre-engineered turbo system from Tornado Alley Turbo, which launched the turbonormalizing of the SR22 on its own. TAT had demonstrated good aftermarket capability, and a new clean-sheet design developed entirely by Tornado Alley Turbo convinced Cirrus to jump back into that market. It sold about 500 new turbonormalized Cirrus

aircraft in the first 12 months.

TAT came up with a more elegant induction air routing scheme to minimize pressure loss, ambient heating and other ills. Plus, it carefully designed the intercoolers themselves to exactly match the under-cowling cooling air pressure/flow characteristic, which not surprisingly couldn't be just lifted from GM's diesel truck intercooler design rule-of-thumb book. The designer even came up with an intriguing cabin heat design. Cabin heat is normally a bugaboo of turbo retrofits as the traditional muffler heat exchange goes away due to lack of space and lack of necessity (turbos are great mufflers, with spinning parts inside), but turbo airplanes really do need heat. The Cirrus system included a cabin heat exchanger with a unique safety feature: If the system cracks, exhaust gas will not leak into the cabin because the cabin air is at higher pressure than the exhaust gas at the cabin heater. Instead, cabin air will leak into the exhaust. That engineer deserves the Carbon Monoxide Poisoning Jonas Salk Award and I'd plan the award banquet.

WRAP IT UP

Intercooler mods need to have STC approval, of course, so you'll need to find one for your particular aircraft. We scanned the market in the September 2015 issue of *Aviation Consumer* and a follow-up reveals there are a few choices. In addition to Tornado Alley Turbo (www.taturbo.com), there's American Aviation (www.americana-aviationinc.com) with its replacement Ultracooling system for Cessna 340 and 414 twins. Installation could take around 45 hours and the kit is north of \$15,000. There's also a kit for Piper Navajo models. Turboplus (www.turboplus.com) has a wide range of intercooler and induction systems for Piper, Beechcraft, Cessna and Mooney models. It says installation ranges from 20 to 30 hours, while prices start at around \$5000.

As mentioned, maintenance is an important consideration so talk with your shop for feedback on what it might take to maintain one on your particular engine.

Contributor Paul Milner is the technical editor for the Cardinal Flyers Online type club and owns a turbonormalized C177 RG based in California.

FLIGHT TRAINING

Step-Up Sim Training: Tailor It For You

The best aircraft upgrade training is simulator based. A good training facility should be willing to customize the training to fit your particular needs.

by Rick Durden

A combination of more than a decade of economic growth, a soft aviation insurance market (although that appears to be changing) and relatively low selling prices for used piston twins, turboprops and light jets has resulted in a healthy number of piston single owners giving serious thought to stepping up to more capable—and demanding—airplanes.

Any owner with the financial wherewithal to step into the world of aircraft with engines that go “whoosh” is smart enough to immediately talk the idea over with his or her insurance broker. In addition to getting a ballpark estimate for the cost to insure a used King Air, Citation Mustang or new HondaJet, one of the first things the prospective owner will hear from the broker is that any insurer is going to require upgrade training at a facility approved by the insurer.

INSURANCE REQUIREMENTS

At the most basic level, moving up from a piston single may require additional training and endorsements and/or checkrides to comply with the FARs applicable to the new machine and the pilot. That may include such

things as getting an instructor's endorsement under FAR 61.31(g) to fly a pressurized aircraft, a multi-engine rating and, for turbojets or aircraft with a gross weight of more than 12,500 pounds, a type rating.

All of the FAA-required training may be obtained from a properly rated CFI followed by—in the case of a new rating—a checkride with a DPE.

The reality is that just complying with the FARs will not be enough for your insurance company—it will require that you go through training at a program it approves, and most of those are simulator-based, something we applaud. Plan on spending a bare minimum of \$4000 for piston-twin upgrade training. The price goes up from there based on the type of aircraft involved and the amount of training you require to reach proficiency—which may include a mentor pilot flying with you for some hours following the formal training course. Once you get into the world of jet type ratings training cost can be

Ready to step up to a TBM? Your insurer is going to require simulator-based training.





Evening thunderstorms depicted in a simulator at SimCom, top. Beech Baron 58 simulator at SimCom.

north of \$30,000.

There are in-the-airplane-only training operations still in existence, but they have become rare. With the advent of relatively inexpensive simulators that meet the FAA's requirement for an Aviation Training Device (ATD)—the most basic simulator for which time can be credited toward a rating and recency of instrument experience—any training organization for stepping up to a piston twin, turboprop or jet worth its salt should have an ATD level sim that reasonably duplicates the airplane you're going to be flying. We think any-

thing less than that is a deal breaker.

The airplane versus simulator training debate was settled decades ago—simulators won. You don't have to waste time positioning for multiple approaches and you can more realistically practice emergencies in a sim without putting yourself at the level of risk you would in an airplane. After all, sim devel-

opment was pushed by the airlines because their professional pilots were killing themselves during in-airplane training.

IN-AIRPLANE TRAINING

Nevertheless, we recognize that in-airplane training is valuable. There are a few things that a simulator doesn't do as well as an airplane. For one, duplicating the effects on the pilots of a pressurization failure. As multi-type-rated pilot Michel Litalien told us, "You can do pressurization failures in a simulator all day long, but until you pressurize the airplane, take it to 14,000 feet, dump the pressurization and feel the effects, you don't have a gut-level understanding of what depressurization in the flight levels would really involve."

We think that if a pilot has limited or no experience in the sort of air-

plane she or he is moving up to that the best training program will be primarily in the simulator but also include dual in the airplane itself. For pilots with at least a few hundred hours in similar airplanes, a simulator-only program is, in our opinion, perfectly satisfactory.

USER FEEDBACK

We received input from a number of pilots regarding their experience with upgrade training. We were particularly interested in comments from two piston twin owners because we are of the opinion that one of the toughest upgrades is to a piston twin due to the complexity of older and often user-unfriendly systems combined with purely awful performance on one engine.

Dr. Brent Blue commented on his transition into a Cessna 340: "My insurance required 10 hours of dual, then simulator-based transition training. I thought I was pretty competent after the dual until I got into the sim. What an eye-opener! You just cannot practice engine outs in the aircraft as you can in the sim. Same for single-engine IMC approaches.

"I had my first real engine out in Denver, night and IMC, just after takeoff about six months after my upgrade training. I went around and landed. The only thing that seemed different than the sim was all the firetrucks lined up and down the runway!"

T310R owner Mike Busch said, "Sim training is absolutely essential for anyone who flies a piston twin and doesn't have a death wish. I managed to kill myself quite a few times during sim training and then when I had an actual engine failure four years ago in the airplane, it was pretty much a non-event (except for my wallet, of course)."

Busch went on to point out something that we hadn't considered: "The ground school portion helps with maintenance costs. Knowing how the systems work and how to troubleshoot them helps isolate problems for the A&P."

For piston twin upgrade training our survey of simulator-based providers indicated that most courses lasted four to five days and involved on the order of 10 hours of ground school and five to seven hours in a

The route to that open door of the Cirrus Vision Jet, above, is through a Vision Jet simulator in upgrade training, below.

simulator with about two hours in the airplane (if in-airplane training was included). The facilities we spoke with said that they “train to proficiency” so the cost, simulator time and course time is subject to revision upward based on the ability of the pilot to meet the course standards.

Our experience and comments from aircraft owners and training facilities were consistent: If a pilot does not show up multi-engine and instrument current and comfortable and willing to single-mindedly work on the course, he or she will have difficulty completing the course in the basic time allotted. (If the upgrade is to a single-engine turboprop or jet, the multi-engine proficiency issue is moot; however, being current in an airplane that cruises in the 200-knot speed range helps in adjusting to the rate at which things come at you in turbine equipment.)

MOTION

We did not find any piston twin training centers that used motion-based simulators. While we agree with a 2012 study published in the *International Journal of Aviation Psychology* that concluded that there was “no evidence that simulator motion improves flight performance in real aircraft,” some users did not.

We heard from piston twin owners who had trained in FlightSafety International’s motion-based simulators before FSI stopped doing piston twin training and who told us that they have been unable to find any training provider that now gives piston twin training at the level FSI did. The FSI rep we spoke with said that the company has gone to all Level D simulators (the highest currently available) and it was no longer financially feasible for them to provide piston twin training.

Interestingly, we found that upgrade courses for single- and multi-engine turboprops (not requiring a type rating) were not much longer than those for piston twins. SimCom (www.simulator.com) is the big dog in the simulator-based flight training



world. Eric Hinson, CEO of SimCom, told us that initial training courses for turboprops usually run five to six days, and make use of Level A to D sims as well as nonmotion Flight Training Devices (FTD)—depending on the type of aircraft—and may include training in the customer’s airplane.

Hinson emphasized the importance of using simulators that were as close to replicating a customer’s aircraft as possible. We think that is important during upgrade training so that the pilot can take advantage of primacy in learning and more readily transfer what is learned in the simulator to the airplane to be flown.

INSTRUCTOR QUALITY

Hinson openly discussed what is too often a dirty little secret in upgrade training—while the syllabus may be standardized, much of the quality of the training is dependent on the quality and experience of the instructor. He said that finding and retaining quality instructors is important to ensuring that pilots who come for initial training will return to SimCom when it’s time for recurrent training.

The quality of individual instructors was a constant refrain in our conversations with users as they related good and bad training experiences. Our take on the matter is that a training customer is paying big money for good instruction and the training organization should be prepared—and willing—to smoothly



change instructors if a customer runs into a problem.

TYPE RATINGS

The upgrade world changes a bit when a type rating is required, largely because most training courses increase in sophistication and take at least two weeks.

FlightSafety International (www.flightsafety.com) is considered by many to be the gold standard for type-rating training. While thought of as primarily catering to the professional pilot world, it aggressively markets to owner pilots, especially for smaller jets such as the Cessna CJ series and the HondaJet.

The usual curriculum involves 14 days of classroom and simulator time and is designed to take a commercial, instrument, multi-engine pilot with no jet time through a type rating. Nevertheless, it is not a one size fits all affair. FSI has long tailored its training to fit the student—and provides mentor pilots to support owners after they complete training.



FlightSafety International's training facility for the HondaJet: Level D full-motion simulator, top; graphical flight simulator with dynamic system displays, middle; classroom desk-top simulators that mimic the jet's avionics suite, bottom.

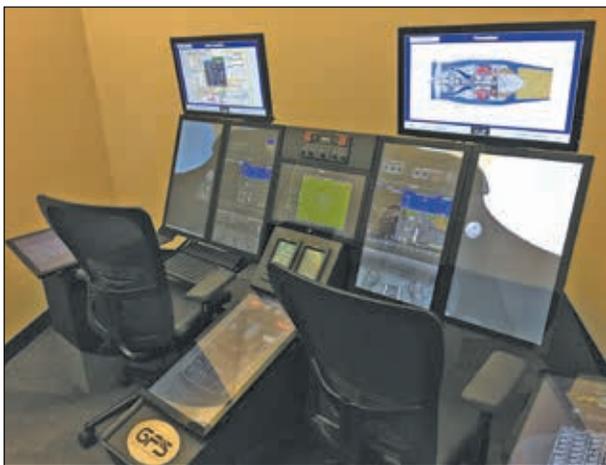
To keep the cost to a minimum, show up ready to go—instrument current and with the decks cleared so that you aren't distracted during training. For the three- to six-day upgrade courses for piston twins and turboprops, have read the POH and training materials at least once. Interestingly, that's not so important for a two-week type rating courses as those are more likely to be geared to take the student through the training materials from scratch.

Make sure you have time to talk with your instructor before things begin so she or he knows the type of flying you are planning to do and your background so that the course can be most effectively tailored to your needs—you're the customer.

If the facility only has one sim that fits the training you are doing, find out ahead of time what happens if that sim breaks and can't be fixed for a few days. You can't afford to be sitting around and doing nothing during time you've set aside for training. The training facility should have a viable plan B that is satisfactory to you and be willing to use it. We got some unpleasant stories from users on the broken sim issue.

As you get near the end of sim training, ask the instructor for her or his "scenario." Every instructor who knows his or her airplane well has one. The pet scenario almost invariably involves flying the airplane at the edge of its abilities and will help you get to know the capabilities of the airplane.

Flying around the Statue of Liberty and then landing on the 700-foot-long Manhattan Heliport in a jet may sound silly to talk about, but when you do it and discover that you are getting to know the airplane well enough that you can pull it off, you'll have made great strides to becoming one with your new flying machine.



The students next move into a graphical flight simulator with full-scale displays, touchscreens and, importantly, dynamic graphic system schematic displays at the top. The system displays show what is going on as the pilot works through normal, abnormal and emergency operations of the various systems. When a fuel valve is moved,

the display depicts just what that action has done within the fuel system.

Finally, the student steps into the full-motion, Level D simulator. As a side note, we've found Level D sims are able to remarkably, realistically duplicate flight operations and are possessed of superb displays. It's no wonder that those who pay more than \$25,000 for Level D sim type-rating training consider the money to be well spent.

RECOMMENDATIONS

We strongly recommend upgrade training at a facility that has a sim that can replicate your airplane, and its avionics, as closely as possible. We think it will save you money in the process of getting comfortable in your airplane.



We toured FSI's HondaJet training facility, one we think reflects its overall approach to training. Training begins in a classroom where the student is introduced to "operation day flow," which means they start using desktop simulators that mimic the jet's avionics suite. The idea is to move into flight scenarios early.

AirVenture Diary: More ADS-B, LSA Regs

We don't need more portable ADS-B gadgets, but there were new ones at Oshkosh. We do need an update to the LSA weight limits and it's coming.

Staff report

Working from our news trailer in the media ghetto at this year's AirVenture in Oshkosh we waited—patiently—for the big product announcement that might define the show for 2018. But it just didn't come. The weather was good, attendance was good and we were generally underwhelmed by what we saw while browsing the hangar exhibits, listening to the media briefings and walking the grounds.

Still, there were enough new product announcements worth logging in our annual AirVenture diary. Herewith is a summary, starting with everyone's favorite—avionics.

AVIONICS AND ADS-B

Garmin usually comes to the show with a gadget or two and this year it brought its latest-gen aviator watch—the D2 Delta. The Delta is actually a series of watches to include the \$1249 D2 Delta PX, which has a wrist-based pulse oximeter; the

\$899 D2 Delta S (with a lighter and smaller profile for petite wrists); and the \$949 D2 Delta, which has a silver titanium bezel and a brown leather strap.

All of the watches connect to the Garmin Pilot app, the GTN750/650 panel navigator and the latest G1000 NXi for flight plan transfer when equipped with the Flight Stream 510 wireless cockpit hub. The watches have integral music storage for 500 songs, which can be wirelessly streamed to Bluetooth headsets and audio panels. There's also Garmin Pay, a built-in wireless payment system.

Forget using the Delta PX to replace a medical-grade pulse oximeter. Garmin made it clear that the PX model, with its wrist sensor pulse oximeter function and 18 hours of battery life, isn't a substitute for traditional pulse oximeter medical instruments, but can be used for trend monitoring and general awareness.

More significant is that Garmin's G5 electronic flight display can be installed as a legal STC'd backup to the G500/G500 TXi flight displays. Believe it or not, previously this interface required an FAA field approval because the G500-series primary displays didn't include the G5 in the STC. The technical interface is expanded, too, and for the better. Any adjustments made to heading bugs, altitude select, airspeed bugs and baro settings are automatically synced from the G500 TXi or G500 displays to the G5. Flight director and autopilot mode annunciations from the GFC 500 can also be viewed across all displays, including on the G5. No, the G5 isn't approved for backup in Cirrus models. That means if you have a second-gen Aviadynne Entegra or even G1000 Cirrus (or any other G1000 airplane) the G5 is off limits.

Garmin also announced updates to its Pilot app, which can display EIS (engine instrumentation system) engine data when connected to the TXi engine display via the Flight Stream wireless hub. There's also a new weather radar—the GWX75—which we'll cover in an upcoming report.

For its first time at AirVenture, German company TQ-Avionics brought what could be the lightest certified VHF comm radio on the market, the KRT2-S. It's packaged in a 2.25-inch round chassis and has a color TFT display. The company also has the KTX2-S transponder, which is packed in a similarly tiny chassis.

TQ has roots planted deeply in commercial aviation, providing some avionics for Airbus and other airline equipment. The company was also showing a glass flight display for the experimental market. Moving forward, we think TQ-Avionics is the company to watch. It's made tremendous progress in the past couple of years with avionics that are appropriately packaged and competitively priced for the GA market.

The Opener BlackFly electric personal VTOL ultralight, left, was an attention getter at Oshkosh. The dual-wing craft uses eight electric motors and flies at 62 MPH.





Clockwise from lower left: In the gadget department, Dynon Avionics was showing the \$995 D3 Pocket Panel portable EFIS. Appareo launched the fourth-generation Stratus 3, which has an open architecture for interfacing with apps other than ForeFlight. Garmin brought an updated series of its aviator watches, the D2 Delta. The flagship model shown center has a pulse oximeter.



ForeFlight introduced an ADS-B receiver of its own called the Sentry. The \$499 device was designed and built in a partnership with uAvionix and in addition to ADS-B weather and traffic, provides backup attitude for the ForeFlight app, a rechargeable 12-hour battery and—a first for portable ADS-B receivers—a carbon monoxide monitor and alarm. The device also has a high-capacity data card that supports a weather replay feature, which provides automatic storage for up to 30 minutes of FIS-B weather and data.

Appareo Systems brought its latest-gen ADS-B receiver to the show—the Stratus 3. The big news with it is its compatibility with more third-part tablet apps, including the Seattle

Avionics FlyQ program using the industry-standard GDL90 protocol, although it still works with ForeFlight. It has smart Wi-Fi circuitry that now allows you to use 3G/4G LTE internet on the iPad while it's connected to the Stratus. It also has automatic shutoff. The Stratus 3 is \$699 and has the same footprint as the previous Stratus 2, so you can use the existing mounting hardware.

BendixKing had a strong showing. It was displaying the AeroVue Touch retrofit flight display and the company said certification is expected before the end of this year. It also showed the experimental XVue Touch, which has been shipping and is installed in a variety of aircraft.

The other news from the company is the AeroVue integrated flight deck for existing B200 King Airs. After years of being snagged in the certification process, it now has STC approval for installation.

The AeroVue, which trickles down from the Honeywell Apex avionics suite used in the Pilatus PC-12NG, plus has technology from the company's business aviation applications, has three color displays (two PFDs and one MFD), including engine display and a pedestal-mounted flight management controller with CCD (cursor control device); it doesn't have a touchscreen interface.

The system is equipped with mandate-compliant ADS-B Out, weather radar, SXM satellite weather, TAWS-B terrain alerting, active traffic alerting, plus it has the company's AeroWave inflight cabin connectivity. We flew with the system at AirVenture in the company King Air and are preparing a full report for an upcoming issue of *Aviation Consumer*.

LSA WEIGHT LIMITS

LSAs are now limited to 1320 pounds for land-based aircraft and 1430 pounds for float and flying boat designs. But the limits have been a longstanding gripe among manufacturers because they restrict the design limitations of aircraft by sacrificing durability and safety features at the expense of useful load. Many LSAs have only enough useful load for two full-sized adults and partial fuel and manufacturers have been asking for more flexibility to build more useful aircraft. Also, the weight limits exclude many legacy two-place aircraft by a few hundred pounds and owners and type groups have been lobbying to have dozens of designs included in the classification. In a news conference at AirVenture, EAA Chairman Jack Pelton said changes to LSA weight limits are about halfway through the four-year rulemaking process and are aimed at fixing what many consider the most serious problem with the aircraft classification.

Textron Aviation was showing off the full-scale cabin mockup of the Cessna Denali turboprop single, top/middle, while Vashon Aircraft used the show for an official public unveiling of the Ranger LSA, bottom.

"They're addressing the weight limits of LSA," Pelton said, adding that weight won't be the sole criteria in establishing eligibility. He said it will be more focused on establishing the class of aircraft that should be allowed to fly under the simpler licensing and certification standards of LSA. Pelton said the new performance-based regulatory attitude of the FAA is behind its sudden flexibility on the LSA regs and he's been assured the changes are moving through the process.

DENALI TURBOPROP, BLACKFLY ULTRALIGHT

Textron Aviation proved that the Cessna Denali single-engine turboprop is getting closer to flight testing, displaying a full-scale mockup of the entire passenger cabin and cockpit. The mockup, which had a fully assembled executive interior with aft seats removed to accommodate a motorcycle, also had Garmin's G3000 integrated avionics.

The Denali will be powered by the 1240 shaft horsepower full FADEC-controlled Catalyst engine, which was developed by GE Aviation. It will have a digitally optimized single-lever engine/propeller control and be mated with a 105-inch diameter McCauley five-blade constant-speed composite propeller, which has reversible pitch and ice protection. The GE engine will have a 4000-hour TBO and the aircraft will have a 1600 NM high-speed cruise range when loaded with one pilot and four passengers.

Textron said the Denali is projected to have cruise speeds in the 285-knot range and full-fuel payload of 1100 pounds. The Denali will have a digital pressurization system that maintains a 6130-foot cabin altitude at 31,000 feet.

Textron told us that flight testing is slated for 2019, followed by production in 2020.

On the opposite end of the spectrum was the Opener Inc. BlackFly VTOL ultralight. The carbon-fiber



BlackFly is equipped with eight electric motors. Each motor weighs four pounds and generates 130 pounds of thrust. Opener reps say the company has been testing motor-rotor sets for more than three and half years, covering a distance equivalent to 20 circumnavigations of the globe. There are two batteries per each engine-rotor pod.

The BlackFly is restricted to 62 MPH in the United States. The BlackFly's unique canted wings fore and aft provide lift in level flight, easing the burden on the lift rotors. With a 25 percent reserve, it can fly for about 25 miles before a recharge. With a regular 110-volt outlet, it can charge in seven hours, and in only one hour using a 220-volt outlet. While version three has not yet flown, version two has made more than 500 takeoffs and landings, often with worst-case-scenario engine failures programmed into the test card. Like a modern drone, the BlackFly has a "go to home" feature, auto-land and a ballistic parachute.



The company couldn't tell us how much the BlackFly will cost when it's available for purchase in 2019. Opener's sales director Alan Eustace (he served as senior VP of knowledge at Google, and has held the world record for highest-altitude free-fall jump since Oct. 24, 2014) told us it will be priced "competitive with the price of an SUV." We'll be watching and reporting on the BlackFly project.

More Low-Cost EFIS: Prices Tumble Lower

Startup AeroVonics has two multifunction instruments intended to replace vacuum gyros. Dynon adds syn vision to the new D3 portable.

by Paul Bertorelli

If we haven't reached the point where you can no longer afford to keep your iron gyros, surely we're not far from it. At AirVenture 2018, yet another startup introduced a low-cost EFIS—two, actually—and across the field, Dynon unveiled the D3, its latest low-cost portable EFIS.

Albuquerque-based AeroVonics

came from the blue with the AV-20, an \$800 miniature EFIS and a planned \$1600 instrument that will compete squarely with Garmin's brisk-selling G5. As interesting as that might be, the backstory is even more intriguing. AeroVonics products are pushing the FAA's relaxed certification protocol to the limit, suggesting that more products may be on the way under the FAA's NORSEE process. (See the sidebar, right.)

REPLACEMENT MARKET

AeroVonics has in mind inexpensive replacements for vacuum instruments with its AV-20 and AV-30 self-contained multifunction instruments. The \$800 AV-20 fits into a 2-inch instrument hole—the size of a typical clock—and provides 11 discrete functions, including attitude, AoA, bus voltage,



flight timer, TAS display, G-meter and a clock. There are actually two versions of the instrument. The AV-20 is a minimal variant that doesn't have the gyro sensing. It will sell for about \$499. The AV-20S packs all the features. We saw the instrument

demonstrated at AirVenture and although it appeared to have some sort of extraordinarily sharp display, AeroVonics' Jeff Bethel says no, it's just a garden-variety TFT. But the AV-20's software tweaks the graphic processing at the sub-pixel level, giving the instrument dense colors and smooth refreshes.

All that's required to install it is the FAA's NORSEE letter and plumbing into the aircraft pitot/static system, plus power and ground. Like most avionics these days, it's agnostic on voltage—14 or 28 volts will do. It has an internal battery the company says will operate it for at least 30 minutes in backup mode. Most owners will probably engage an A&P to install it and other than a logbook entry, no further paper needs to be shuffled.

AeroVonics was awaiting the final NORSEE approval at press time and expected to be able to deliver products within a few months. The AV-20 doesn't have inputs beyond the plumbing and power and is meant as a supplemental standby, not a replacement gyro.

AV-30

But AeroVonics has a larger instrument for that task, the 3-inch AV-30, selling for \$1595. While Garmin's G5 and Dynon's D10A occupy a similar space in the certified panel market, the AV-30 has some features no other gyro in this class has. Like the others, it's intended to be a primary attitude gyro to replace vacuum instruments.

For certification, AeroVonics will use the AMOC route—alternate means of compliance—that Bethel describes as between the NORSEE path and an elaborate STC-AML process. For its AV-30 program, AeroVonics will have to show compliance with RTCA's DO-160 hardware-testing protocol, but not DO-178, which covers software. Bethel says that saves an enormous amount of testing dollars and allows the low price point for an instrument usable

AeroVonics A-30, upper left, electronically renders an old-school AI, but with digital data overlaid. AV-20, lower photo, has 11 discrete functions, including an AI.



Dynon's new D3, above, adds synthetic vision and touchscreen control to a battery-powered portable EFIS.

in certified aircraft.

AeroVonics plans an approved model list that won't cover everything flying, but will allow installations in the majority of the piston fleet. The approvals will allow the removal of vacuum systems.

Like the AV-20, the AV-30 has a long list of features, but it adds HSI/DG mode, GPS navigation data overlay and vertical speed trends.

Unique to the AV-30 is the ability to configure the electronic display to look just like a conventional blue-over-brown mechanical gyro, but with airspeed, altitude, baro and other customizable fields displayed digitally. Or, at the push of a key, it can be configured as a conventional DG.

You can see where this could go. For \$3200 in hardware, you could readily replace both a vacuum AI and DG for a price about \$1500 less than doing the same with Garmin's G5 AI and DG combination. How about attitude autopilot support? Nope, neither the AeroVonics products nor the G5 pair offer this capability for legacy autopilots, although both have heading interface for rate-based autopilots such as the S-TEC line. AeroVonics says adding this capability is a certification hill too steep to climb, at least for now.

DYNON D3

In 2012, Dynon leveraged its expertise in inexpensive panel-mount equipment to produce what it called the D1 Pocket Panel. It was a battery-operated portable EFIS

NORSEE SHAKES THINGS UP

If you've bought an iPad mount from Guardian Avionics or a BOM from Level Aviation, you might know what a NORSEE letter is because you got one in the box. Otherwise, what the heck is NORSEE?

NORSEE is an FAA acronym for non-required safety enhancing equipment. It appeared about two years ago when the FAA had an internal eureka in realizing it was actually *decreasing* safety by requiring stringent approval for aftermarket equipment like AoA indicators, electronic gyros, stability control and the like.

NORSEE is not an Advisory Circular nor a regulation, but an FAA policy letter, specifically PS-AIR-21.8-1602. It does provide regulatory relief in the sense that it allows manufacturers to field a specific list of 10 safety-related devices without completing a cumbersome STC/AML process or some other regulatory step through.

It hasn't seen much use yet simply because manufacturers either didn't have the listed products or weren't sure how NORSEE applied to what they did have. Specifically, NORSEE can be applied to traffic advisory systems, terrain advisory, attitude and angle-of-attack systems, weather advisory gadgets, configuration advisory devices, extinguishing systems, monitoring

and detection and stability and control. While the hoop jumping to obtain the NORSEE letter is not zero, it's simpler and cheaper than the months-long process of proposing a test program, having the FAA approve it and then submitting the test results. As electronics grew ever more cheaper and capable, this process of itself kept some products off the market.

NORSEE assumes the installation of the covered device will be a minor alteration and it further assumes that whatever is installed will fail without adversely affecting flight safety. AeroVonics' instruments represent the first purpose-made multifunction instruments approved under NORSEE.

"According to the FAA, we're pushing the boundaries from a complexity and sophistication point of view. We're right at the hairy edge of what they were ever going to approve under NORSEE," says AeroVonics' Jeff Bethel.

He said the FAA had concerns about displaying attitude because, heretofore, loss of it was considered a significant failure. But attitude display is clearly listed in the NORSEE letter, so the FAA had little choice but to go along. The results, thus far, are instruments notably less expensive than the competition.

with a MEMS-based solid-state gyro similar to that used in certified AHRS systems. There's no air data, of course, so the displayed altitude and airspeed is GPS-derived, meaning the latter is really groundspeed, not airspeed.

The D3 introduced at AirVenture is the third iteration of this product and this time around, Dynon has eliminated the side bezel controls in favor of the more familiar touchscreen technology smartphones have. The D3 has a rudimentary pulldown menu structure that's intuitively self-explanatory.

The instrument also has synthetic vision to bring a little terrain aware-

ness to the party. It also includes a G-meter, a slip-skid ball and GPS vertical speed.

Being a portable, the D3 requires no approval. It can be mounted anywhere in the cockpit using a RAM suction cup or into an empty instrument hole using Dynon's snap-in squeeze mount. AC and DC power adapters are sold with the D3 at price of about \$879, discounted.

For more on AeroVonics, see www.aerovonics.com and find Dynon at www.dynonavionics.com.

You Tube See a video of these EFIS products at <http://tinyurl.com/j95ht2a>.



Piper Twin Comanche

It's not the fastest light twin, but it's efficient, has pleasant handling and sports timeless good looks.

When we looked at the current Twin Comanche market, we found that owners generally prize the Piper Twin Comanche for the same reasons that they always have. It's a relatively affordable, economical and accessible twin with decent performance. There isn't much more to ask for. In many ways, it's one of the few twins that can claim to be not much more expensive than a single to own and operate, but that's only if you buy the right one. There are plenty of basket cases in the weeds. But there are some pretty nice ones, too, and you'll pay top dollar for them.

Prices of Twin Comanches have softened over the years, but they haven't plummeted, either. It's possible to find one with a spiffed-up panel and new paint for around \$80,000. Although some haven't had many panel upgrades, others have been upgraded to full glass and high-end custom leather seating. You'll pay big for those.

MODEL HISTORY

The Twin Comanche first saw the

light of day in 1963 and between then and 1972, Piper built about 2150 Twin Comanches in its Lock Haven, Pennsylvania, plant—the same factory that produced the venerable Cub. By any measure, the Twin Comanche was sleek and sporty compared to the airplane it followed, the dowdy, bulbous-nosed PA-23 Apache. (That airplane eventually evolved into the PA-23-250 Aztec, a strong airplane for Piper in its

Because of its stingy fuel burn, the Twin Comanche has excellent range and payload tradeoffs.

own right.) The Twin Comanche has two designations, PA-30 and PA-39.

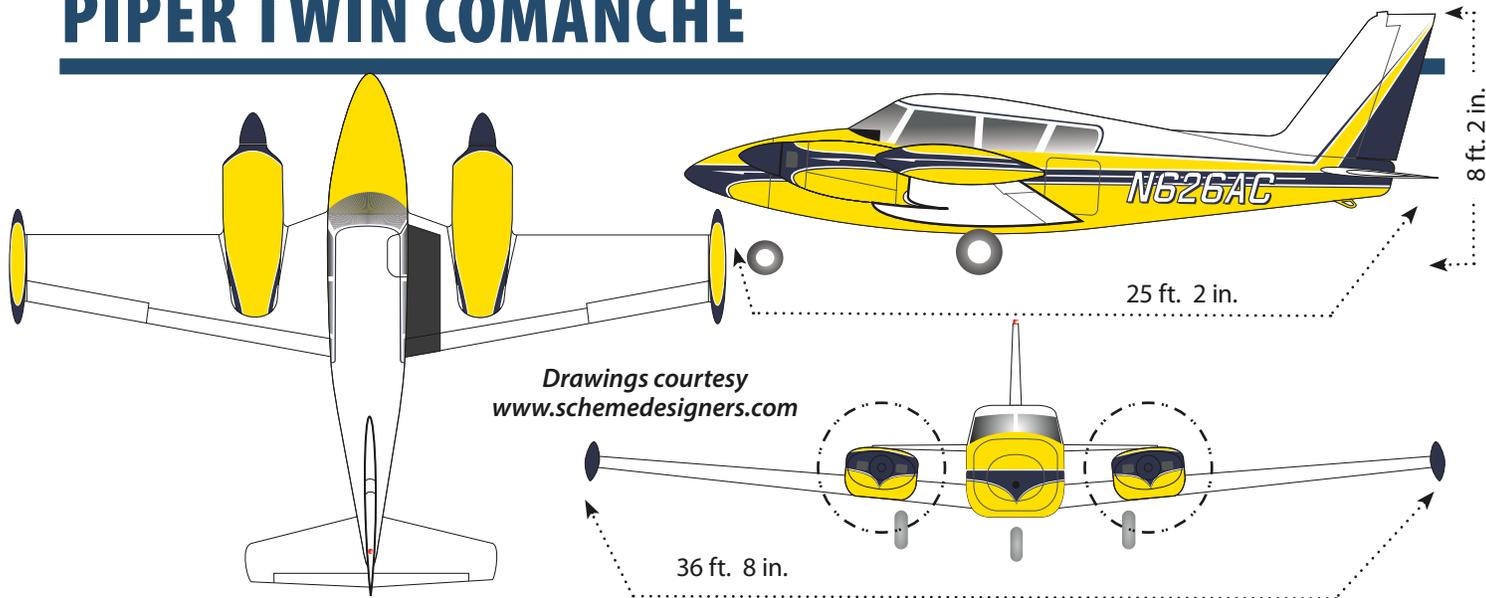
The first Twin Comanche shared two things with its slower predecessor, the Apache: It had four seats and the same basic 160-HP Lycoming O-320 powerplant. One difference is that the PA-30 has the injected version of the O-320, the IO-320-B1A. Cabin room was virtually identical in both airplanes.

But the Twin Comanche was clearly a different airplane. Compared to the Apache's short and squat looks, the "Twinkie" was rakish, with a sloped windshield, a pointed nose, tiger shark engine nacelles and even optional tip tanks. With cruise speeds as fast as 170 knots, along with miserly fuel burn, the Twin Comanche proved popular among private owners, flight schools and charter operators.

In 1966, Piper introduced a new Twin Comanche—the PA-30B. Although it has two extra seats, it really isn't a six-place airplane for anything but the shortest flights and the smallest people. The extra seats eat up the baggage space and the useful load of 1350 pounds allows just a half load of fuel if all six seats are filled. Given the airplane's low fuel consumption, half fuel is enough for 300 miles or so, but it's not realistic to think of the Twin Comanche as a six-place airplane. (There are windows for the fifth and sixth seat passengers, but

That's Carl Miller's award-winning restored 1964 PA30 in the lead photo.

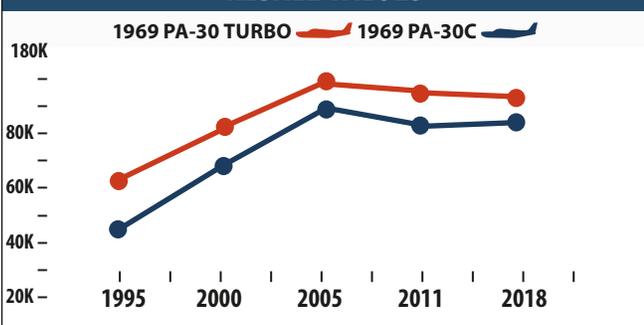
PIPER TWIN COMANCHE



SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1963-1965 PA-30	160-HP LYC IO-320-B1A	2000	\$25,000	90/120	1390	169 KTS	±\$62,000
1966-1968 PA-30B	160-HP LYC IO-320-B1A	2000	\$25,000	90/120	1350	169 KTS	±\$80,000
1966-1968 PA-30 TURBO B	160-HP LYC IO-320-C1A	2000	\$25,000	120	1317	194 KTS	±\$85,000
1969 PA-30C	160-HP LYC IO-320-B1A	2000	\$25,000	90/120	1330	172 KTS	±\$90,000
1969 PA-30 TURBO C	160-HP LYC IO-320-C1A	2000	\$25,000	120	1290	209 KTS	±\$100,000
1970-1971 PA-39 C/R	160-HP LYC IO-320-B1A	2000	\$25,000	90/120	1370	172 KTS	±\$85,000
1970-1971 PA-39 C/R TURBO	160-HP LYC IO-320-C1A	2000	\$25,000	120	1390	192 KTS	±\$95,000
1972 PA-39 C/R	160-HP LYC IO-320-B1A	2000	\$25,000	90/120	1370	172 KTS	±\$90,000
1972 PA-39 C/R TURBO	160-HP LYC IO-320-C1A	2000	\$25,000	120	1200	192 KTS	\$100,000

RESALE VALUES

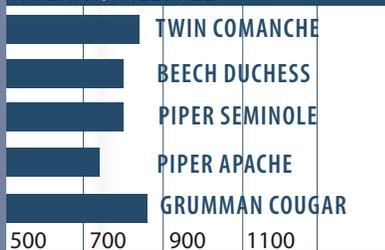


SELECT RECENT ADS

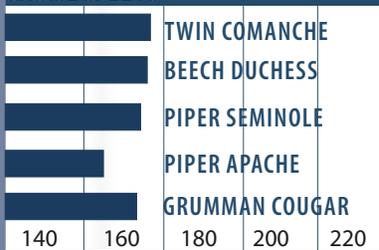
- AD 97-01-01 GEAR SIDEBRACE STUDS INSPECTION
- AD 94-13-10 STABILATOR TORQUE TUBE INSPECTION
- AD 83-19-03 LOWER SPAR CAP CHAFING
- AD 83-10-01 REPETITIVE FUEL-SYSTEM INSPECTION
- AD 77-13-21 LANDING GEAR COMPONENT INSPECTION

SELECT MODEL COMPARISONS

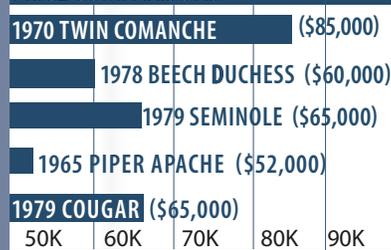
PAYLOAD/FULL FUEL



CRUISE SPEEDS



PRICE COMPARISONS





Modern avionics and a new instrument panel like the one in the 1969 turbo Twin Comanche shown at the top boost resale value. The one at the bottom has older Garmin navigators and a Sandel EHSI.

they're better at illuminating what's really a large baggage compartment.)

In an era when turbocharging wasn't common in light aircraft, Piper brought out the PA-30 Turbo B in 1966, with optional factory-installed RayJay turbochargers, boosting potential speeds to 190 knots in the mid to high teens. Nor were these the seamless, automatic wastegate turbos we're used to today. Each turbo had a wastegate controlled directly by a mechanical cockpit knob. Although such a system is cheap

and reliable, it imposes yet another cockpit duty on the pilot. By modern standards, when FADEC is in the offing, it's quite crude. For any pilot not used to this system, flying it can be like running a steam locomotive.

In 1969, Piper introduced the PA-30C, which offered minor improvements. Among these was a new instrument panel with an offset radio rack and flight instrumentation in the classic T-pattern, rather than Piper's traditional hodgepodge arrangement, which many of the earlier airplanes still have. The last of the Twin Comanches was the PA-39 series. Distinguished by its counter-rotating engines, this series was regarded by many as the finest of the Twin Comanche line and, say many owners, the one to buy. These are bargains at between \$75,000 and \$120,000.

Twin Comanche production ended

in 1972, a victim of both a declining market and Tropical Storm Agnes, which drove the Susquehanna River over its banks, flooding the Lock Haven plant. By then, Piper was already established in Vero Beach, Florida, but neither the single nor the Twin Comanche variants made the transition to Vero.

MARKET SCAN

With more than 2000 built, there are usually plenty of Twin Comanches to pick from in various stages of repair, restoration and upgrade. We think a prospective owner should be thinking in the \$70,000 to \$120,000 range. According to the *Aircraft Bluebook*, the PA-39 C/R—first year 1970—sells for about \$85,000, still a bit more than a 10-years newer Seminole but about the same as a Beechcraft Duchess. The *Aircraft Bluebook* value dropped \$10,000 since we looked at it roughly eight years ago. Still, depending on avionics and other major upgrades, that number could vary as much as \$25,000 or more.

Despite being longer in the tooth than the Duchess and Seminole, the Twin Comanche still enjoys the edge in both speed and efficiency, although Beechcraft fanatics will swear the Duchess wins for handling. We think it's easier to land gracefully.

But if money matters the most, the days of piston twin-engine airplane appreciation are long over; the game has turned defensive. In that regard, our sense is the Twin Comanche has done better than most, depreciating less than some other twins, almost surely because of its low operating costs. And even if the twin market isn't robust, there's always some demand from owners comforted by the notion of a second engine, accepting twice the fuel burn and more engine maintenance. There's never a free lunch.

PERFORMANCE

Depending on model and year, Twin Comanche owners report cruise speeds of 160 to 210 knots on 13 to 16 gallons per hour, all up. Our guess is that the median cruise is closer to the lower number than anything above 200 knots. Generally, airplanes with higher cruise speeds have various speed-boosting mods. An unmodified, normally aspirated

Look at the windshield and roof line of the Twin Comanche and you'll see the resemblance to the PA-24 Comanche single. The Twin Comanche's cabin isn't a huge dwelling at 44 inches wide, nearly the same as a Beech Baron.

Twin Comanche can best be thought of as a 160-knot airplane.

While it's true that this isn't faster than some modern singles, having the second engine is important to some owners. With backup vacuum and electrical systems, tackling low IFR or night operations is less stress inducing, even if the airplane isn't exactly stellar on one engine.

Like any light piston twin, the Twin Comanche will eke out a climb with one engine caged, but you won't suffer a nosebleed during the ascent. If everything is done just right and the weight isn't too high, look for about 200 FPM of climb, or a bit more. (Interestingly, the Diamond DA42 hasn't bettered that performance with its diesel engines, nor would we expect it to. The Lycoming-powered version, however, delivers a solid 350 FPM on one engine.)

When it was first introduced and thanks to its popularity as a multi-engine trainer, the Twin Comanche suffered somewhat of a tarnished reputation with regard to handling on one engine. On a number of training flights, V_{mc} demonstrations got out of hand (thanks, in part, to V_{mc} speeds being optimistically marked 10 knots lower than today). So, V_{mc} and stall speed could be nearly the same. This proved to be an unnerving and fatal experience for a number of unsuspecting students and their instructors. (Many of those instructors probably were on the green side themselves.)

The stall/spin syndrome was aggravated by the FAA's then ill-advised recommendation that V_{mc} maneuvers be performed at as low an altitude as possible—to get full asymmetric power. This, coupled with a wing that tended to lose lift all at once in a stall, helps explain the series of training accidents. This sort of carnage wasn't unique to the Twin Comanche, by any means. The fact that the training community has wised up since the 1960s probably does more than any factor in explaining why the plane has a typical



accident record and isn't considered especially nasty on one engine, despite the anemic climb rate.

On the PA-39—the Twin Comanche variant with counter-rotating props—stall strips that weren't standard on early models were installed on every airplane. Counter-rotating props provided an additional safety benefit by eliminating the critical engine. The FAA also issued an AD requiring that V_{mc} be increased to a more realistic 72 knots. Another feature on late-model Twin Comanches is interconnected aileron and rudder controls. Owners say it keeps the ball almost dead center without rudder coordination, during reasonable rates of turn and bank angles.

Overall, handling of the Twin Comanche is predictable with only one quirk: takeoffs and landings. Here, the aircraft can be a bit of a rascal. It's

difficult to obtain consistent, graceful landings because if held off the runway, the airplane tends to pay off with a jolt. And on takeoff, the Twin Comanche wants to fly before V_{mc} .

Developing techniques to deal with these peccadilloes is a frequent topic among pilots. For takeoff, owners learn to avoid pre- V_{mc} liftoffs by holding the airplane in ground effect until V_{mc} . This takes some deft handling, since it can lead to nervous skittering on the runway or porpoising. On landing, the Twin Comanche is a floater until, all at once, it isn't, with a thud passengers tend to notice. When the wing sheds its lift—all at once—the gear goes kerplunk! Generally, these rude arrivals are laid on the tapered, laminar-flow wing and stubby rear main gear. To make matters worse, the stabilator seems to have limited authority during the flare.



Owner tells us the Comanche's landings are safe, even if they're not pretty. The accident record isn't quite as convincing, but it's not exactly damning, either. Advice abounds on improving landings, including installing a smaller nosegear tire or raising the flaps during the flare to dump the lift and pin down the airplane.

RANGE, PAYLOAD

Because of its stingy fuel burn, the Twin Comanche has excellent range and payload tradeoffs. A few years ago, one owner wrote us gloating that with a 120-gallon capacity—thanks to tip tanks—he could fly halfway across the continent with fuel to spare. “Who could ask for more on a nickel budget?”

The first Twin Comanche carried 90 gallons in four wing tanks. Like the single-engine Comanche, it had four seats, with baggage space behind the rear seats.

Unlike other models, gross weights of Twin Comanches didn't evolve much. The first models had 3600-pound gross weights with empty weights of around 2300 pounds, for a useful load of 1300 pounds. With 90 gallons of gas aboard, that left 760 pounds—just enough for four people and some bags but not that much different from the load-hauling capability of many stout singles.

The PA-39 C/Rs have gross weights of 3725 pounds but empty weights of around 2500 pounds for even less useful load than the earlier models. With 120 gallons of fuel aboard, allowable cabin load declines to 500 pounds or so. But thanks to those economical engines, that much gas translates to seven hours of endurance and exceptional range. It's both practical and possible to offload fuel in exchange for cabin load.

MAINTENANCE

AD-wise, the Twin Comanche isn't a killer. The landing gear bungee cords are supposed to be replaced every 500 hours in service, or every three years, whichever comes first. Some TC experts say this should be done annually. The bungee cord AD was promulgated in 1977 to prevent the landing gear from collapsing after a manual extension. It also helps in retracting the landing gear and, when it's too worn out to do this, the gear circuit breaker is likely to pop.

Unusual for most models, the Twin Comanche has had some one-time ADs for structural issues. While we know of few accidents caused by breakups, owners have reported that aileron spars are especially fragile components, with cracks developing under the hinge brackets.

An AD to solve this problem required the installation of new hinge brackets. After compliance, the 100-hour inspections can be discontinued. However, reports from the field indicate that it would be prudent to continue examining this area.

The LoPresti Aviation cowling and spinner mod (top two images) is said to increase cruise speed up to 7 MPH. A typical Twin Comanche normally aspirated Lycoming engine overhaul is around \$35,000, bottom.



That's Len Duncan's PA-30B. It has RayJay turbochargers and he reports 175 knots at 17 to 18 GPH when flying in the teens.

The Twin Comanche's engines have an excellent service history, which goes a long way toward making the airplane relatively affordable as twins go. Like the airframe itself, the engines are the target of relatively few serious ADs and many of those are of the shotgun variety.

Our sweep of service difficulty reports found few smoking guns worth mentioning. Many of the complaints related to what can best be described as aging aircraft issues—old airplanes that haven't been well maintained. In turbo twins in particular, corrosion in engine mounts has caused problems in years past. Trouble spots are the areas where exhaust heat tends to weaken the metal.

On the normally aspirated models, heat fatigue problems on the engine mounts also have been reported. Other problems to watch: Magneto coils can develop resin leaks due to overheating, heat exchangers can become burned or cracked (this was the subject of an AD requiring an expensive 500-hour overhaul) and the spinners on the Twin Comanche's Hartzell props can develop problems.

MODS, OWNER GROUP

Twin Comanche owners agree that the International Comanche Society is a worthwhile organization. Members receive a monthly magazine, Comanche Flyer, and technical help from the society. Currently, the society has more than 3000 members,

with regional "tribes" throughout the U.S. For prospective Twin Comanche buyers, the society offers a book describing what to look for in a used Twin Comanche. The ICS can be reached at www.comancheflyers.com or by phone at 888-300-0082.

Although the list of modifications for the Twin Comanche isn't as long as it is for some airplanes, any airplane in service for four decades has been tinkered with. LoPresti Aviation offers an improved cowl, flap gap seals, spinners and spats. When we talked with LoPresti, it told us the cowl and spinner mod adds a total of 7 MPH in cruise. We're told there are over 400 speed kits in the field. Contact LoPresti at www.loprestiaaviation.com or 772-562-4757.

Knots2U, another speed mod house, has a similar product line, along with windshield, lighting and nosebowl kits, to name just a few in Knots' large product line. Contact www.Knots2u.com or 262-763-5100. Hartzell is aggressive in offering new prop conversions for all aircraft, including the Twin Comanche. Contact 800-942-7767 or www.topprop.com.

OWNER FEEDBACK

Owing to its contemporary styling, performance, efficiency and comfort, a cult following among Piper Twin Comanche owners exists. Piper, with plenty of help from Ed Swearingen, got it right the first time. There are seven variations of the model, ranging from naturally aspirated IO-320 engines, to turbonormalized versions, four-place seating to six-place seating, plus an STC'd version with 200-HP engines. But for all intents, these are really four-place airplanes.



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TWIN COMANCHE MISHAPS: OTHER

We have been of the opinion that the Twin Comanche got an unfair rap when it came to developing a reputation for a high rate of V_{mc} LOC (loss of control) accidents. We felt that was because the airplane came of age in the 1960s when the FAA was tacitly encouraging V_{mc} demonstrations at low altitude and there wasn't much time for an instructor to catch a student who fell off the training tightrope—and the Twin Comanche was a popular multi-engine trainer.

However, after going through the 100 most recent Twin Comanche—PA-30 and PA-39—accidents, we do have a concern about the rate at which pilots lost control after power was lost on one engine, whether due to a mechanical issue (several were due to lousy or no maintenance), contaminated fuel or absence of fuel.

We counted 15 V_{mc} -related crashes, eight following power loss shortly after takeoff and seven in other phases of flight. We noted that in many of the accidents the pilot had not taken action to follow the emergency checklist to maximize the chance of continuing the flight—by doing such things as feathering the prop on the offending engine, retracting the gear and/or retracting the flaps.

In addition, we saw two accidents where an instructor chopped power on one engine on the takeoff roll and the student didn't close the throttles in time to keep from running off of the runway—and the instructor didn't or couldn't react fast enough to keep it from happening.

Based on our experience in looking at aircraft accident reports on a monthly basis, a combination of engine/mechanical-induced and fuel-related power loss events leading to 30 reported accidents is not out of line. What got our attention was that half of those events led to a V_{mc} LOC crash, most of which were fatal. Because V_{mc} LOC usually results in a violent roll off—often beyond the

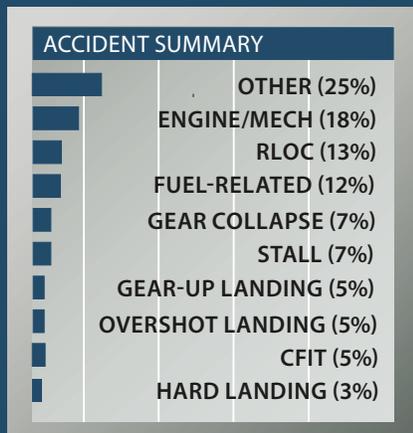
vertical—the subsequent impact is rarely survivable because the aircraft hits inverted, steeply nose down, or both.

We have flown the Twin Comanche and like its efficiency and handling, but the LOC following power interruption numbers indicate to us that it is essential for any pilot who flies one to take regular and frequent recurrent training that emphasizes single-engine procedures and airplane performance under different loadings and density altitudes.

There were seven stall accidents in the reports we reviewed, most either after takeoff (some over gross) or while maneuvering below 1000 feet AGL.

Gear collapses and gear-up landings accounted for 12 incidents—there wasn't enough damage to categorize them as accidents. In nearly half, the pilot did not follow the fairly precise instructions in the emergency gear extension checklist and could probably have extended the gear. In others poor maintenance doomed the extension attempt or caused the collapse while a couple of pilots simply forgot to fling out the Firestones.

We have no sympathy for the pilot who selected “gear up” prior to beginning the takeoff roll and then let the airplane get a little light on the wheels, which allowed the retraction system to lower the airplane to noisy contact with the runway.



A potential new owner will likely fret about spare parts for a 50-plus-year-old airplane. To date that has not been a problem. Things that rotate (engine, prop, governor, pumps) are easily overhauled. Webco refurbishes the fuel selectors, Matt Kurke of Comanche Gear (www.comanchegear.com, 239-593-6944) refurbishes the landing gear motor/transmission. The only exception is if the airplane has suffered a gear-up landing or had a gear collapse because there are few shops that have the tooling to fabricate new ribs/formers/longerons.

The easiest way for the new buyer to determine if the plane had a previous gear incident is to remove the lower wing root fairing, and with a flashlight and feel, determine if there is a skin splice along the fuselage at the chord line. When the planes were built, Piper used a continuous skin from the door sill to same location on the pilot's side.

A stock normally aspirated Twin Comanche with minimum speed mods will typically cruise at 190 MPH (166 knots) at 8000 to 9000 feet. The turbocharged models do best between 16,000 to 17,000 feet, resulting in typical cruise speed of 213 MPH (185 knots), but at the expense of a much higher fuel burn.

My airplane is a bit unusual. Not only have I installed the majority of the mods that I believe are effective, but I've created a number of my own. In particular, attention has been focused on cooling drag, which is the third highest drag component after skin friction and form drag. In smooth air and standard conditions running maximum manifold pressure and 2450 RPM, I see 175 knots indicated at 9000 feet.

The landing gear, when properly maintained, is very robust and trouble free. Problems arise when maintenance is deferred. Every 1000 hours the nosegear and the main landing gear toggle link assemblies are removed from the plane for detailed inspection and measurement. This should only be done by a highly qualified shop with Comanche experience.

Upon reassembly, the gear is timed and proper preload adjustments made. If the friction drag on the main gear conduits is excessive, new conduits from Webco or Piper are installed. I recommend that every five years the preload should be determined and

any adjustments made. The flexible conduits creep due to compression loads when the gear is down.

Using a clamp-on ammeter, excessive friction is present when the gear is cycled on jacks and a current draw greater than 20 amps is measured. I also recommend changing the bungees every year since their purpose is to reduce the load on the gear motor/transmission during the retraction cycle. There is a companion AD to inspect the toggle link pivot pins.

The original seats (especially the early models) are not exactly comfortable. Modern Piper seats from other models are easily swapped out (Lance/Saratoga/Seneca/Cherokee should work). I have high-back seats from a Lance in my 1964 Twin Comanche.

Most normally aspirated Twin Comanches have an empty weight close to 2400 pounds when modern electronics, lightweight starters and alternators are installed, and when attention is paid to weight uppers (heavy paint, unnecessary equipment and excessive baggage).

The plane is almost able to carry four 170-pound occupants and full fuel. It's a certified gross weight issue, not one of aerodynamics. With tip tanks, the gross weight becomes 3800 pounds.

The Twin Comanche is a reliable, easy to maintain aircraft with minimal system complexities. Plus, Piper's replacement—the Seminole—lacks the speed, burns more fuel, climbs much slower and lacks the Twin Comanche's service ceiling.

Hans Neubert
Anaheim, California

My Twin Comanche was the AOPA 2004 win-a-twin sweepstakes airplane. I bought this aircraft six years ago from the man who won it. The real costs of the annual inspections are hard to determine because I have been doing upgrading throughout the years that I have owned this bird.

During my ownership I have rebuilt or replaced many airframe and control items including the landing gear motor and transmission, all of the engine control cables (mixture, prop, throttle and alternate air), fuel selectors, rebuilt the air boxes, trim drum, gas heater gas valve and completed the 1000-hour gear inspection. That



being said, what a normal annual would cost is difficult for me to determine. As for the modifications that I have done, they include changing the wheels and brakes to accommodate hubcaps on the main gear wheels.

I reworked the instruments and avionics, adding a Garmin G600 PFD, a GTN 750 navigator, GDL88 ADS-B and GDL69 SXM receiver, JPI 960 engine monitor, a Quattro standby EFIS, USB ports, autopilot altitude preselect, an AoA indicator, readback recorder for ATC communications, wingroot fairings and trailing edge filllets.

I also added LED strobes and nav lights, engine cooling baffles for increased cooling and speed—which had the best result of any speed mods I retrofitted.

Last, I added MT three-blade props. I like the way they look but have not flown enough to know the difference between the MTs and the Hartzell Q-tip props that were on previously.

As for performance, N204WT has tip tanks for a total of 120 gallons of fuel. I plan for around 16 GPH. In cruise, I lean to around 7 GPH per engine and see 165 knots.

The endurance is much longer than my body's, but staying in the air without fuel stops will definitely reduce your block-to-block times. The useful load is 1325 with the tip tanks—a little less without them, but also a little slower with them.

I believe the best resource for information about Comanches—twins or

N204WT shown above was already rebuilt in 2004 for the AOPA sweepstakes, but new owner Dave Winters has been upgrading and replacing systems over the last six years.

singles—is the Airworthy Comanche forum at www.forums.delphiforums.com. There are many Comanche-savvy contributors who seem to know everything there is to know about Comanches. Kristin Winter is the mastermind keeping the forum going. Hans Neubert has written the book on Twin Comanche speed mods and performance at www.comanchepilot.com, plus there are many other experts. Another resource is the International Comanche Society (ICS).

The Twin Comanche is a solid airplane, a pleasure to fly and is fast and efficient. I also owned a single-engine Comanche and the operating costs were not much different than the twin. But, the maintenance of the Twin Comanche is more.

Still, as far as owning a twin-engine airplane, I think the Twin Comanche might be the most affordable.

Dave Winters
via email

TWIN COMANCHE

(continued from page 31)

I purchased my Twin Comanche, N8513Y, one year ago from an owner who had maintained it very well. This turbo Twin Comanche has the distinction of being Howard "Pug" Piper's personal airplane built for him after he and Ed Swearingen designed and then turbocharged the Twin Comanche. It passed on to his son Howard "Chip" Piper after a short time, who had the factory repaint it to its original scheme before he sold it to the owner before myself.

As you would expect it is a highly optioned airplane and now has every speed mod I am aware of. With a Garmin G500, Electroair ignition and Electronics International engine monitors it is a good IFR platform. Without the turbo at 12,000 feet it flies 155 knots on 12 GPH.

With turbos at 12,000 it flies at 180 knots on 18.5 GPH. At 24,000

feet I plan for 190 knots.

I transitioned to this airplane from a turbocharged Mooney because I cross the Rockies and live in the mountains. To make flying it safer, I had Bill Archer in Phoenix, Arizona, train me and landed it on one engine so many times it felt strange to use both. Every time he cut the power I was exceedingly glad there were two engines. It is a much more stable platform in the clouds than the Mooney, handles turbulence much better and with my checkride I had to show that I could keep the needles centered even mid-final on an ILS losing my left engine. It is simply not true that a light twin takes you to the scene of the accident if you lose an engine. I have once cut my fuel too close and starved an engine at 24,000 feet. Even at that altitude it was manageable and there was none of that "piano" feeling that happens in a single.

It runs cool at altitude with the turbos and with the LoPresti Wow Cowl mod I see 330-degree CHTs with the turbos off and 360 degrees with them on. The extra work of the turbos is not that bad for a "motor-head" like me. The extra vernier controls for the

The Twin Comanche's systems are reasonably easy to access for maintenance and we're told parts are easy to source.



FEEDBACK WANTED

PIPER/SMITH AEROSTAR



We're preparing a report on the Aerostar twins in an upcoming Used Aircraft Guide in *Aviation Consumer*. We want to know what it's like to own these airplanes, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your airplane to appear in the magazine, send us any photographs (full-size, high-resolution please) you'd like to share to the email below. We welcome information on mods, operating expenses or any other comments that can be helpful for buyers considering one. Send correspondence by October 15, 2018, to:

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Email at:
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turbo wastegates are simply treated like an extra sensitive set of throttles. I burn a little extra fuel to keep the engines healthy.

My first annual (owner assisted) was comprehensive and cost about \$3000. I insure only for liability and it was \$1800 for the first year. Now, full coverage will be about \$2400 with recurrent training—which is absolutely essential for a light twin. This airplane approaches the efficiency of a Mooney. Not once when my instructor shut off one of my engines have I wished it was a single. Watch your speed while turning on one engine, but it definitely adds safety in the mountains.

Douglas Crane
via email