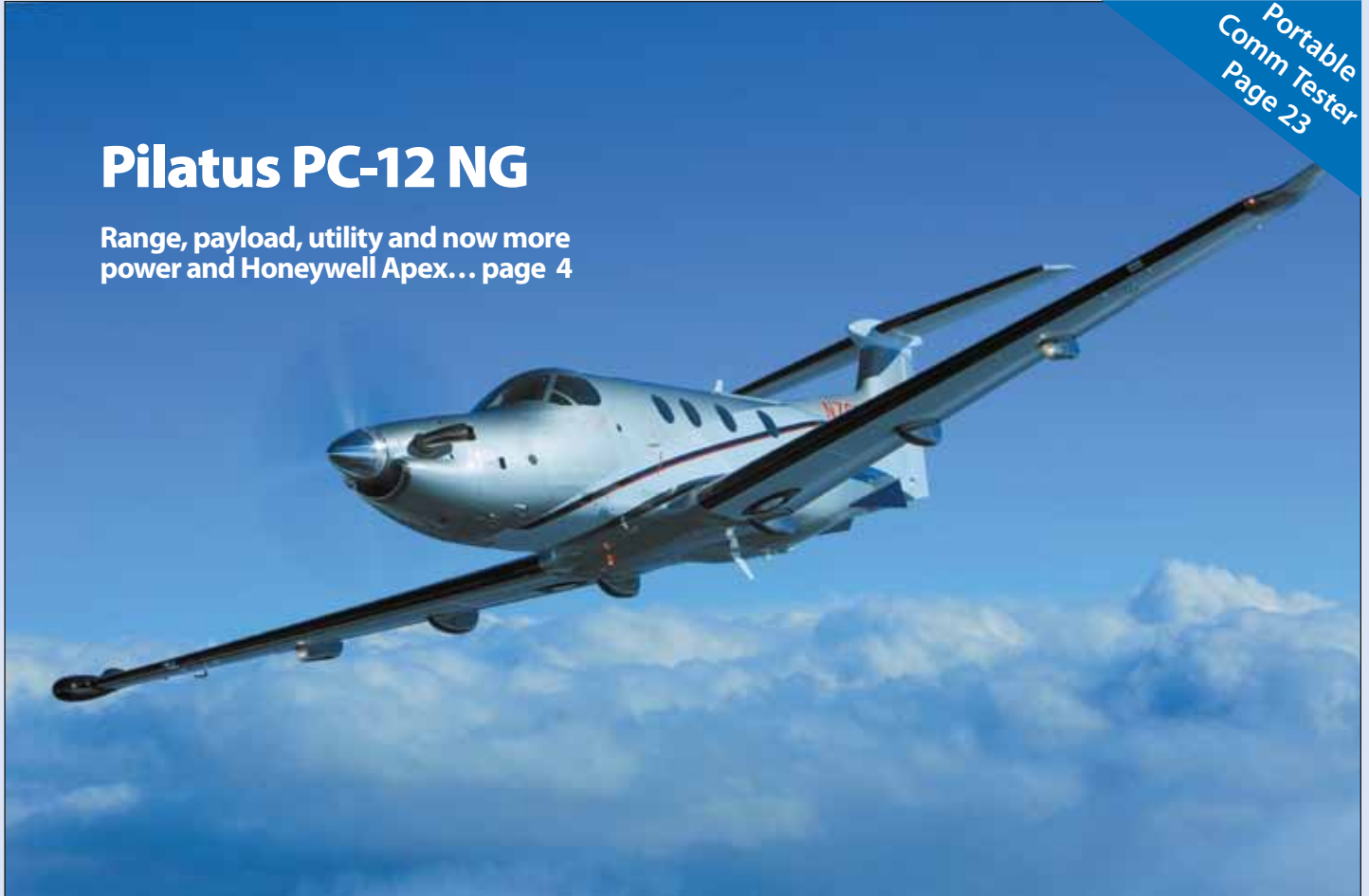


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EDITOR

Rick Durden

MANAGING EDITOR

Larry Anglisano

EDITORIAL DIRECTOR

Paul Bertorelli

CONTRIBUTING EDITOR

Jonathan Doolittle

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 5W1

Canada

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FIRST WORD

They Put the Fuel Tank *Where?* In a New Airplane?

As pilots and aircraft owners, we always seem to be worried—justifiably, I think—about fuel. We're concerned about price; apprehensive about a reliable supply in the future (Paul Bertorelli has an article about one potential solution on page 12), cautious to assure we have enough on board, with reserves and, should we have an accident, we know, in that primitive place deep inside us where our fears reside, that the fuel we have been relying on can kill us.

Until the mid-1950s, it was pretty common for smaller general aviation airplanes to carry their fuel in a tank between the engine and cabin. The reasons boiled down to ease of design and manufacturing cost. For some years, the fact that those tanks would rupture in even low-speed accidents, leading to post-crash fires, was not considered of importance.

By the mid-1950s, the combination of the high accident rate in general aviation and the number of post-crash fires got the attention of scientists and engineers. Questions were asked as to why a crash of such airplanes as Cubs, Champs and Chiefs that should have seen occupants walking away with



minor or no injuries were fatal because the fuel tank opened up and a major fire started before anyone could get out. That airplanes with fuel tanks in the wings, such as Super Cubs, were not as likely to burn did not escape attention.

NACA, then NASA, did full-scale crash testing in the 1950s through the early 1970s. Cessna, Piper and Beech got involved—providing airplanes to be crashed and engineers to evaluate what happened during impact sequences. What was learned about crash dynamics changed the way general aviation airplanes were built. Restraint systems improved, airframes were designed to absorb impact forces by crushing rather than transmitting the energy to the occupants and fuel was stored away from the cabin.

The result was that post-crash fires in general aviation airplanes became less common. There's no way of knowing how many lives were saved or people who weren't hideously burned. But now, when a Cirrus pilot loses control on landing and smacks into a fence post at 30 MPH, the odds are everyone inside will walk away—so long as they were wearing the restraints. It takes a pretty high-speed impact to open up the fuel system and start a post-crash fire in a modern general aviation airplane—except, of course, in Hollywood.

I fly Cubs and Champs with some frequency. I'm aware of the post-crash fire risk—but I'm willing to take that risk when flying a 70-year-old design that has a market value of about \$20,000. However, there are some LSAs that are priced far, far higher and are touted as being of the latest design—yet they carry their fuel in a tank in the nose, the location that, in my opinion, was so long ago considered to be unacceptable in an airplane marketed to the public.

I fully recognize that designers agonize over every pound in an LSA. They cannot incorporate every single safety concept that has been discovered for general aviation. Yet the location of the fuel tank is so basic, and so much research and testing went into the subject, that I cannot understand how engineers would countenance such a design today. What were they thinking?

Were the designers simply ignorant of the vast amount of data on fuel system design? Was it a lack of knowledge of the history of aircraft design or failed institutional memory? Did they know and not care?

One thing history has taught us for certain—if airplanes are sold, some of them will crash. While all flying involves risk, knowing what we know about design, accident rates and risk of post-crash fire, I don't think a nose fuel tank design is appropriate in a production airplane in this century. —Rick Durden
Cover photo by John Dibbs, The Plane Picture Company, Redmond, Washington.

Lycoming Overhauls

I received your 2013 *Aviation Consumer Buyer's Guide* and was very interested in your article covering engine overhauls. One important fact I did not see is: Customers who are thinking about ordering a Lycoming factory overhauled engine need to know about Lycoming's 36-year policy. If the customer's engine left the Lycoming factory more than 36 years before the order date, Lycoming will not accept that engine for a factory overhaul.

It can only be used for core credit for a new or rebuilt engine.

Right now, 1977 is 36 years out, and 1977 through the early 1980s was one of the busiest times in history for aircraft production.

I believe that many owners do not know about Lycoming's 36-year policy on factory overhauls. If an owner is planning to get a factory overhaul on a Lycoming engine, he or she may need to do it based on the calendar rather than the condition or TBO if up against the 36-year number.

Please note, having the engine field overhauled after it left the factory does not extend or restart the 36-year clock under Lycoming's policy.

Dave Rogers
Air Power, Inc.

Remote Heater Controls

I'd like to add some information to your September 2013 article on remote control units for preheaters. For those who buy a preheater from Reiff Preheat Systems, we offer a remote control switching unit that can be operated via a telephone call for the price of \$89. Because we feel that a remote switching unit is of value to our preheater customers, we offer one at our cost—no markup.

Bob Reiff
Reiff Preheat Systems

A Little Respect

I very much appreciated the piece by Rick Durden, "A Little Respect," in the October issue. The first paragraph says it all; there really should not be a place for aviation snobbery. Any aircraft that leaves the ground and returns in controlled flight deserves respect, no matter how the landing gear is configured. There is no place for looking down on airplanes just because they have a nosewheel.

I have an RV-6A, fly formation with the West Coast Ravens, including a number of large formations

such as the 40 ship over Oshkosh. It's a great plane and a blast to fly, nosewheel and all. What is even more important are the RV and formation communities as positive forces for general

aviation. What a great group of aviators. They don't care whether an airplane has a nosewheel or tailwheel—they just want it to fly.

I previously owned a 1947 Ercoupe, which I flew for 11 years and 1500 hours. I loved every minute of it. The Ercoupe has been one of those airplanes that lacks the cool factor in certain segments of the aviation community, particularly among those who prefer tailwheel airplanes—the 'coupe is probably dead last in cool for that group. Yet it deserves respect. It allowed me a number of years of flying that I might not otherwise have been able to afford.

Before I owned my RV, I flew my Ercoupe with the SoCal RV group to and at events. They were always encouraging and supportive. They never put down the Ercoupe—they referred to it as an RV-0.5A.

The Ercoupe was what my budget could afford—I have no regrets or apologies about admitting it. Thank you for the gentle reminder about respecting the airplanes we can afford to fly.

I believe the important thing is to keep all of our airplanes and aviators

safely flying—especially the more modest planes that make aviation more accessible to those of us with limited budgets.

Dan Hall
Via email

Cockpit Lighting

Larry Anglisano's October article about lighting options in the cockpit was good, but I've taken a different approach, a temporary system that I hold in place in my Tiger with Velcro, just as some pilots do with a flashlight.

It is an eyebrow LED light bar built by Fresh Aero (www.freshaero.com), with an integral off/on and dimmer switch. It can be removed from the airplane in two minutes. It plugs into an ELT battery pack that is secured under the pilot's seat. The battery easily powers the LED bar all night, as I've inadvertently proven. It's perfect for the fairly low amount of time I fly at night.

The poor-quality OEM lighting system is unaffected. I have absolute redundancy of lighting for little more weight than a powerful handheld flashlight. Because it is not installed in the airplane, the FAA is not involved at all.

Brent Smith
Via email

CONTACT US

Editorial Office
616-901-6516
E-mail: consumereditor@hotmail.com

Subscription Department
P.O. Box 8535
Big Sandy, TX 75755-8535
800-829-9081

Online Customer Service:
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Pilatus PC-12 NG: Aviation's Utility Infielder

With a power upgrade, installation of the Honeywell Apex flight deck and new AOA display, the go-anywhere, do-anything turboprop gets even better.

by Rick Durden

Don't let the advertisers lie to you—every design involves compromises. Attempting to optimize any one aspect of a vehicle means accepting less-than-optimal outcomes for other aspects. Ever since the Wrights, trying to come up with an airplane that does everything well has driven more than a few aeronautical engineers around the bend or into other occupations.

That being said, there are a few airplanes that are true utility infielders—seemingly able to do anything needed by their operators. The Pilatus PC-12 is one of them. Back in 2007, when we first reviewed it, we were impressed by its wide spectrum of capabilities—and we think the upgrades, primarily power and the impressively capable Honeywell Apex flight deck, that led to the Next Generation (NG) designation (dontha just love marketing types facing creative block?) have made the aircraft even more able.

Sure there are compromises—it's a capable back-country airplane but

not a STOL design. It's not as fast as some turboprops, but it carries a lot more than they do and there are more fuel-efficient turboprops, but they don't have the cabin size.

Delivering 1200 PC-12s in 19 years to every sort of private, governmental and military user that can be imagined seems to indicate that Pilatus made the right design choices, in a user-friendly manner.

LOAD IT UP

The PC-12 NG we flew had a basic empty weight (which includes the pilot) of 6528 pounds. With 2704 pounds of fuel in the wings—the full 402 gallons usable—it was possible to put 1218 pounds of payload in the cabin. That's six 200-pound passengers in the top-of-the-line BMW-designed seats, in addition to the pilot, and a community toilet kit.

Full fuel gives an NBAA IFR range with a 100 NM alternate airport of 1200 NM—VFR range is in excess of 1800 NM. Filling the bigger-than-a-King Air 250 cabin with people and

CHECKLIST



Capable of being a primitive load-hauler or executive transport.



Honeywell Apex flight deck reduces pilot work load and increases safety.



Occupant restraint system needs to be brought up to date.

stuff to the max zero fuel weight of 9039 pounds allows carrying 1400 pounds of fuel, more than half tanks. Max landing weight is 9921 pounds, meaning that after a max weight departure, 529 pounds of fuel, or just under 77 gallons, have to be burned off—a bit more than an hour's flying time.

Our weight and balance calculations indicated it would take some creative loading to get the PC-12 NG out of CG. Of course there's an app for weight and balance that allows the calculation to be run in a matter of seconds.

The cabin layout is sensible. The 53-by-52 inch cargo door is positioned aft of the wing trailing edge. As the airplane is targeted at a number of markets, including owner-pilots, air ambulance, corporate, military, law enforcement and surveillance, there was a desire to make certain that the pilot did not have to walk through the cabin when securing the airplane for departure.

Once everyone and everything is in the cabin, the cargo door is closed from outside by simply depressing and holding a button on the aft fuselage (letting go of the button stops the door, reducing the risk of an ouch). The pilot then boards via the airstair forward, closes it and turns left into the cockpit without disturbing what's going on in the cabin.

In the executive configuration, there is a lavatory opposite the airstair. Doors, immediately forward and aft of the lav, close completely across the cabin, making it private.

CABIN

As a comparison, the cabin is slightly larger than a King Air 250. At \$4.6 million, the PC-12 NG is less expensive than the King Air, and at 260-

Winglet design was coordinated with aileron configuration to optimize roll control; massive cargo door allows maximum cabin utility (top). Trailing beam gear has 14-inch stroke (middle). Access panels open downward and interior is painted white to help detect leaks (bottom).



280 knots, doesn't go quite as fast, but the King Air will only carry 165 pounds in the cabin with full fuel. We were told that a number of PC-12 owners who moved up to jets came back to the PC-12 because getting a similar cabin size and load hauling ability meant spending three times the money.

Some 70 percent of PC-12s are originally sold into the Western Hemisphere. Those are built in the Pilatus facility in Switzerland, then ferried, sans interior, to Rocky Mountain Metro Airport, in Broomfield, Colorado, where the interior is installed and other finishing touches accomplished.

MISSION FLEXIBILITY

Because of the airplane's ability to loiter—pulling the power back to a cruise speed of 115 knots gives nearly 12 hours of endurance—the PC-12 NG is proving popular in a surveillance role. Using a sophisticated sphere of electronic observation equipment that can be electrically lowered from the hell hole aft of the cabin, a PC-12 can stand off as far as 10 to 15 miles and track a person in a vehicle or on foot.

The airplane is as effective as a helicopter, without leaving the huge noise footprint, and often less expensive. Over the last 10 years, law enforcement and military purchasers have edged out sales to private owners. Big Brother really is watching and he's increasingly using a PC-12 NG.

SYSTEMS

Systems of the PC-12 NG are either simple or automatic and clearly designed to keep the pilot's workload low. The flight controls are a combination of push-rod and cables. The fuel system is housed in two tanks,

one in each wing and is simply "on" or "off." The system automatically balances the fuel between the tanks and annunciates if it fails. The trailing beam landing gear is held up hydraulically, so it can free fall in the event of a failure. The two-buss electrical system is powered by two 300-amp generators—one is a starter-generator. Load shedding is automatic in the event of equipment failures.

CRASHWORTHINESS

The PC-12 NG is well designed from a crashworthiness perspective. Although there is fuel forward of the wing spars, it is protected by a robust leading edge. Our review of accidents showed some wing damage events, but none led to fires. The only post-crash fires involved high-speed impacts from flight. Fuel lines are routed outside the pressure vessel.

Even though a control yoke is used rather than a side stick, it does not project from the panel, waiting to impale a pilot. We were surprised to see an out-of-date design four-point crew and three-point passenger restraints. The seat belt and shoulder harnesses are separate rather than being integrated. Because users are likely to use only the seat belt rather than both the seat belt and shoulder harness, the aviation and auto industries went to integrated harnesses decades ago to reduce the number of traumatic head and serious lower back injuries during impact.

We like that there are three, rather



than two, cabin exits, two doors and the over-wing emergency exit.

PREFLIGHT

The walk-around inspection reveals some other design features we like. Access panels on the lower portion

Honeywell Apex—Integrated Ease

Touted as the precocious offspring of the capable Honeywell Primus Epic integrated avionics system installed on the most sophisticated biz-jets, the Honeywell Primus Apex flight deck uses the computing and graphics core of Epic but is tailored to single-pilot operations and targeted at turboprops and light jets.

Pilatus selected the Apex system as part of the NG upgrade of the PC-12. In our opinion, it was a good choice. After flying the airplane, it was apparent to us that Pilatus aggressively designed the PC-12 NG for single-pilot operation to maximize safety by keeping the workload as low as possible. Apex does the grunt work, does not disturb the pilot with extraneous demands, simplifies the tasks involved in conducting the flight and raises hell when the pilot tries to do something stupid.

The system appears to the pilot as a four-screen (two PFD, two MFD) display (below left), plus keyboard and a between-the-seats hand rest from which everything can be controlled without having to move one's hand around the panel (right).

Apex includes synthetic vision, digital charts, coupled vertical navigation, interactive navigation, traffic, weather and simple, intuitive flight planning. To add to it, while we were at Pilatus' Broomfield, Colorado, facility, we saw the installation of the first Aspen CG100P connected system in a PC-12 NG (below right)—and it's now available as a \$16,000 retrofit. It allows flight planning on an iPad and uploading it to the Apex flight deck as well as turning a couple-of-hour

data update process into a matter of a few minutes.

For the pilot, the integrated nature of the Apex system means many small conveniences. Prior to engine start the backup battery powers one MFD, allowing the pilot to view Nexrad radar, input a flight plan through a simple, intuitive system, get a clearance on comm two and update the flight plan as needed.

Once the engine is running, Apex turns on the generators, the avionics busses, bleed air and the environmental system. After that, all that's left for the pilot to do before takeoff is set flaps, trim and test the stick shaker and pusher—if flaps and trim are not set and the power comes up, Apex visually warns and yells at the pilot, "No takeoff!"

We liked the Apex flight deck a great deal. We liked having it give us the fuel we'd have aboard at our destination and alternate when we finished inputting the flight plan, we liked that when approaching an airport and ATC changed runways and approaches on us, it took only five clicks to change everything needed to set up the new approach, and we especially liked that in turbulence there was a handhold we could grab onto and use the buttons, scroll wheel and track ball on it to program the entire Apex system, including environmental controls, without letting go.



of the nose open downwards and the interior space is painted white so anything leaking or dripping should be immediately apparent. There is a sight gauge to use for checking engine oil quantity—no need to open up the system via dipstick, so no danger of leaving it off. The oil filler has a float valve to prevent oil loss should the cap be left off.

The long-span flaps extend under the fuselage and move on articulating arms milled from aluminum billets and bearings rather than on tracks. The small ailerons have servo tabs that lighten the control forces. Pilatus went through three iterations of aileron, servo tab and winglet design before being satisfied with forces and overall harmony.

Due to the lack of availability of TKS fluid at many places around the world, deice boots are used. They are milled into the leading edges—there is no step or discontinuity between the boot and wing.

Aft fuselage strakes add yaw stability and make the PC-12 NG the only airplane we know of that has no restriction to its flight envelope if the yaw damper is inop.

Entry to the pilot's seat is not difficult, despite the need to maneuver past a control pedestal that extends between the front seats. The pilot's seat has more head and legroom than we are used to in aircraft of this size, something we expect is greatly appreciated in an airplane that can have an endurance of up to 12 hours.

DEPARTURE

Startup is a matter of pushing the start button, introducing fuel as the engine spins up and monitoring to avoid a temperature overshoot. With the flight plan in the Apex system (see sidebar), preparation for departure is stunningly simple: Trims are

CONTACTS

Pilatus Business Aircraft, Ltd.
800-745-2887
www.pilatus-aircraft.com

One of two heated angle of attack vanes (top). PC-12 NGs are built in Switzerland and flown to the Pilatus facility in Colorado for six weeks of interior installation and final touches (middle). Remote avionics boxes are mounted under the cabin floor (bottom).



set, 15 degrees of flap selected and the stick pusher and shaker tested—that's it.

Lined up, it's simply a matter of pushing the power lever to the stop—no need to stop at an intermediate position and fiddle to set torque—it's automatic. We applaud this simplicity, as blasting down the runway behind a power loading of 8.7 pounds per horsepower is no place for a pilot to be head down. At gross weight, on a standard day, the PC-12 NG requires only 2650 feet to launch and clear a 50-foot obstacle.

Raising the nosewheel at 80 knots is a matter of applying moderate back pressure—no yanking and releasing as is the case with some T-tail airplanes. The airplane rapidly accelerates to a cruise climb of 140 knots and ascends at just under 2000 FPM. Once the yaw damper is engaged, it takes care of rudder trim, so there is little to do with one's feet despite what would otherwise be major rudder inputs with speed and power changes on a 1200-HP single.

With new, higher thermodynamic limits for the PT6A-67P engine as part of the NG upgrades, there's more real-world power available for cruise, boosting max cruise speed to 280 knots from 270 knots. It's reflected in a slightly higher fuel burn, although range is minimally affected.

The noticeable effect is a more prompt arrival in the flight levels because the full 1200 SHP can be maintained to a much higher altitude. Maximum operating altitude is 30,000 feet, although going above FL270 is rarely worthwhile from a fuel burn

perspective unless the tailwinds are truly whistling.

During two runs to compare book speeds to real life in the flight levels, we observed that they were comparable—at FL240 the book called for 263 knots on 403 PPH and we saw 265 knots on 410 PPH, although we were nearly 1000 pounds below gross. All in all, planning for a 260-knot cruise on 65 GPH should prove appropriately conservative. And, frankly, what else will haul that much, that size cabin, that high, that fast while burning less than 70 GPH?

SINGLE ENGINE

Of course, the counter is to point out the lack of engine redundancy. The single versus twin argument raging since Lindbergh flew the Atlantic will never be resolved. The ultimate decision as to buying a single versus a twin turboprop is up to those who write the checks, and it's not always rational. Nevertheless, with an engine shutdown/failure rate for PT-6s of better than one in 300,000 flight hours (how much depends on the source), a 16-to-1 glide ratio, a nearly 2000 FPM rate of climb and the ability to glide some 77 NM to sea level from a shutdown



at FL300, engine failure accidents are not anywhere near the top of the risk list for the PC-12 series.

The integrated nature of the Apex flight deck means that should something go wrong, most of the time it is handled automatically. An annunciator tells the pilot what is going on and there's plenty of time to pull out the manual, flip to the appropriate tab, see what effect there will be on the continuation of the flight and follow the appropriate checklist.

The EFIS display uses a "track"-based presentation, which means

TV PC-12 NG VIDEO

AVweb
www.avweb.com

continued on page 32

Glass Replacement: What's Involved

It's acrylic, not glass, and it has a finite life. Here's how to tell when it's time to replace it, what's available to buy and what you can expect it to cost.

by Rick Durden

The glass in your bird is looking a little milky, there's some crazing on the windshield and



a little crack where the pebble hit. Is it time to replace the windows? How can you tell? What's it going to cost? How can I make the glass last longer?

First, it's worth noting that what's on your airplane probably isn't glass, it's acrylic (but, rather than constantly saying "windshield and windows," we'll use "glass" as a shorthand term). Acrylic doesn't last forever, it scratches and discolors, and its longevity depends partially on how you treat it.

TIME?

When is the right time to replace the glass? The answer sounds like that of a politician—you'll know it when you (don't) see it. You don't see out, that is.

The enemies of acrylic windows are sunlight, dust, chemicals and scratches. If

CHECKLIST

-  Glass on hangared airplanes can last over 30 years.
-  UV- and IR-blocking tints can increase the lives of cabin interior materials.
-  Improper care and cleaning can shorten acrylic life dramatically.

you keep your airplane hangared, you can reasonably expect the glass to be good for 30 years or more, according to John Zofko Jr., founder of Great Lakes Aero Products, one of the major aircraft glass manufacturers.

On a tiedown, figure 10-15 years, maybe less, per Scott Utz, head of maintenance at Arapahoe Aero at Denver's Centennial Airport. He also said that high altitude airports mean more intense sunlight exposure, so figure on a shorter life for the acrylic.

Your glass will tell you when it needs to be replaced. Crazing—which is just a lot of little cracks in the acrylic, and milkiess—the whitening that comes from exposure to sunlight, affect your ability to see out of the airplane. Aging glass will manifest itself to you when flying into a low sun or at night. At some point, being realistic, you're going to say that it's time to replace the glass.

Don't just think that crazing is a cosmetic matter that you can ignore by flying only when the sun is high—those cracks that create the effect also are weakening the acrylic. We've seen old side windows break just from the a pilot operating a vent built into the window.

A more serious issue for owners trying to save a few bucks by delaying glass replacement is that the sealant around the glass deteriorates and/or windows simply loosen up in their

An Apache gets a new windshield. Descending from top left: Old windshield out, frame cleaned and prepped for the new one; replacement delivered, ready for install; new windshield in place and secured.

frames over time. That means rain water can get inside the airframe and cause corrosion. This is of particular concern on older Mooneys, although we saw an owner's procrastination lead to such serious corrosion of his 310 that the cost of repair exceeded the value of the airplane.

BY THE BOOK

For unpressurized airplanes built before the late 1990s, there's almost no hard guidance on what is acceptable wear and tear on the windows. The manufacturers provide no criteria as to service limits, so one has to look to FAR Part 43.13's inspection criteria—and it's nearly mute on the subject.

Later airplanes have published tolerances regarding crack lengths and locations on windows, but deal with crazing and milkiness by providing guidance on clarity and line of sight and deferring to the judgment of maintenance technicians.

Scott Utz told us that at his facility, the vast majority of replacements come about when the owner has decided that he or she can't stand the condition any longer. Only a few occur because a maintenance technician calls the degraded or cracked condition to the owner's attention during an inspection.

Sunlight is overwhelmingly the main enemy of aircraft glass. Shops told us that, on low-wing airplanes, the windshield and windows tend to deteriorate at about the same rate—on high-wing airplanes, the side windows are protected from the sun and generally last longer than the windshield or aft windows.

Pipers are more likely to have pilot and copilot windows crack than other brands, with the crack often originating where the OAT temperature probe goes through the windshield.

WHAT'S AVAILABLE

When you look at the options available for replacement glass, you'll be faced with a choice of tint colors (or no tint) and, in many cases, a range of thicknesses.

Color choices are usually clear, green or gray. LP Aero Plastics also offers some bronze and blue tints. Tinting does increase the cost. You may be able to special order darker tints, but only for the side windows behind the pilot. For the windshield

MAKING THE GLASS—STILL AN ART

Even though we generally refer to aircraft windows as glass, most are made out from a cellcast acrylic that comes in optically undistorted sheets cast from liquid polymethyl methacrylate (PMMA) resin, which is poured between cooled glass cells to form a sheet. Aircraft window makers buy these cells in specific thicknesses, then use one of the hundreds of patterns they have created over the years to lay over the cell and cut the acrylic to a shape that can be formed, blown or used as is for a particular windshield or window.

We visited Great Lakes Aero Products in Flint, Michigan, where we watched technicians who have been on the job for longer than some of them care to admit, carefully cut out acrylic shapes according to the patterns pulled from their vast library. (We didn't get to photograph the patterns themselves—they're proprietary—just the bandsaw cutting the acrylic, below left.)

The next step for the vast major-

ity of shapes is a trip into an oven where each is heated to about 350 degrees F so it is pliable. (A few aircraft windows are flat, so those skip the heating and forming stage.)

Working alone or with a small team, depending on the complexity of the shaping to come, a technician draws the hot acrylic shape over a three-dimensional mold built for the specific window or windshield.

Some windows, have gentle curves, such as a Cessna Caravan side window (below right), and require only minor shaping. Others, such as the compound and complex curves of a Cessna 172 or 182 windshield where it wraps around the wing root, require two or three experienced technicians tugging, tapping and imploring the acrylic to match the contours while avoiding visual distortion.

Each windshield and window is inspected for distortion. If it doesn't pass, it's back to the oven to be reheated and reformed.



and front windows, the FAA decided there was a safety issue and, in FAR 23.775, specified a maximum degree of tint—the acrylic must allow a 70 percent or greater light transmission. Manufacturers measure that with a light meter.

UV AND IR BLOCKING

The last decade has brought tints that block ultraviolet and infrared radiation. These are touted—accurately, in our opinion—to reduce the very real risk pilots face of skin cancer and eye damage that comes with flying. As

CLEAR (UNTINTED) WINDSHIELD SELECT PRICE COMPARISONS BY THICKNESS (INCHES)

AIRCRAFT	LP AERO PLASTICS	GREAT LAKES AERO PRODUCTS	BERYL D'SHANNON AVIATION	CEE BAILEY
BEECH V35A BONANZA	\$1008 (0.250) \$1139 (0.312) \$1289 (0.375) \$1539 (0.500)	\$849.58 (0.250) \$1247.62 (0.375 outside milled) \$1357.83 (0.375 inside milled)	\$1350 (0.375)	\$506 (0.250)
1969 CESSNA 172	\$521 (0.125) \$566 (0.187)	\$396.97 (0.125) \$395.90 (0.150) \$394.83 (0.187)	N/A	\$513.19 (0.125) \$424.13-\$513.19 (0.187)
1970 CESSNA 310Q	\$580 (0.250)	\$621.67 (0.250)	N/A	\$550 (0.250)
1973 PIPER ARCHER (two-piece windshield)	\$207 each (0.125) \$226 each (0.187) \$244 each (0.250)	\$151.94 each (0.125) \$173.34 each (0.187) \$195.81 each (0.250)	N/A	About \$150 each (0.125) About \$175 each (0.250) Need serial number for exact pricing.
1975 PIPER SENECA II	\$188 (0.125) \$216 (0.187) \$249 (0.250)	\$171.20 (0.125) \$195.81 (0.187) \$248.24 (0.250)	N/A	N/A

you go up in altitude, your exposure to UV and IR radiation increases. The IR and UV blocking tints should (there's no hard data available) reduce damage to interior plastics and fabrics, as well as keep solar heating of the cabin down somewhat. Ordinary tinting does not block UV and IR radiation.

During our visit to Great Lakes Aero Products, a UV light was shined through windshield material onto a piece of paper. As shown in the photo on the opposite page, the paper fluoresced. As also shown in the photo, the SG (solar gray) tinted acrylic dramatically reduced UV transmission. Great Lakes offers SG for all of its windows and windshields. LP Aero Plastics offers the blocking tints in what it calls UV-SG and UV-GT (green tint).

The UV and IR blocking tints are 25-75 percent more expensive than untinted glass.

THICKNESS

Increasing window thickness reduces cabin noise. In testing we did in a Mooney in 2007, we found that cabin noise level was reduced from 1-3.5 dB, depending on the location within the cabin. General aviation cabins are in the 90 dB range—prolonged, unprotected exposure causes hearing loss. Reducing the magnitude of the sound certainly doesn't hurt.

A thicker windshield is a stronger windshield. We have seen reports of airplanes with relatively new, thicker replacement windshields withstanding bird strikes that, it is believed,

would have broken through original thicknesses windshields. Great Lakes Aero proprietor John Zofko III told us of a recent report of a Cessna 310 that hit a goose. It did not break the 0.250-inch-thick windshield.

Depending on the airplane, thicker glass may need to be milled around the edges to fit in the opening designed for thinner glass. In some cases a thicker window can be ordered from the manufacturer, however, the manufacturer may expressly indicate it does not recommend that particular installation. We were told by Great Lakes Aero that inexperienced shops have had trouble installing thicker windshields and have returned them for original thickness acrylic.

Increased thickness adds about three pounds to the weight of a full set of replacement glass.

Beryl D'Shannon Aviation offers a Speed Slope replacement windshield for the Beechcraft Bonanza. It is a popular conversion that does as its name implies; replaces the original, high-drag windshield on older Bonanzas. Shops advised us that the conversion is often made by owners when they need to replace their windshields—its rarely done while the existing windshield is still in good shape.

THE REPLACEMENT PROCESS

The process of replacing glass means doing what is necessary on the airframe to get at the existing glass—that may mean anything from simply folding back or removing interior fabric or plastic to a major excavation

chore on some composite airplanes. The glass is removed, the area cleaned up so there will be a good seal with the new installation and the new glass installed. The edges of thicker glass may need to be milled to fit the frame.

The method of sealing the windows varies with the manufacturer. Cessna uses a felt seal that must be replaced with the window—the seal itself can wear out. According to Scott Utz, it's not unusual to see windows that are loose within their mountings because the seal is gone. Piper's felt seal is similar to Cessna's. Beech uses a permagum seal that is akin to strips of caulk. Cirrus has a sealant that is similar to fuel tank sealant and easy

CONTACTS

LP Aero Plastics
800-957-2376
www.lpaero.com

Great Lakes Aero Products
810-235-1402
www.glapinc.com

D'Shannon Aviation
800-291-7616
www.d-shannon-aviation.com

Cee Bailey
800-788-0618
store.ceebaileys.com

Ultraviolet light shined on a piece of paper fluoresces. SG (Solar Gray) tinted acrylic blocks UV and IR radiation, helping protect occupants and interior furnishings and keeps the cabin a little cooler.

to work with. Although not used by OEMs, many shops use RTV or silicone sealant.

HOW MANY HOURS?

Shops gave us ranges for glass replacement on various airplanes. For a Cessna 172, figure on a windshield install to run 24-30 hours; all glass 50-60 hours. The 172 windshield is tricky with all the compound curves.

A Piper Arrow windshield runs six to eight hours total; it can be done in a day. All glass usually takes about 20 hours. Piper is the easiest to replace because just a little bit of the interior needs to come out.

In general, older Mooneys are easier than newer—the newer, cleaner airplanes have more body work to deal with.

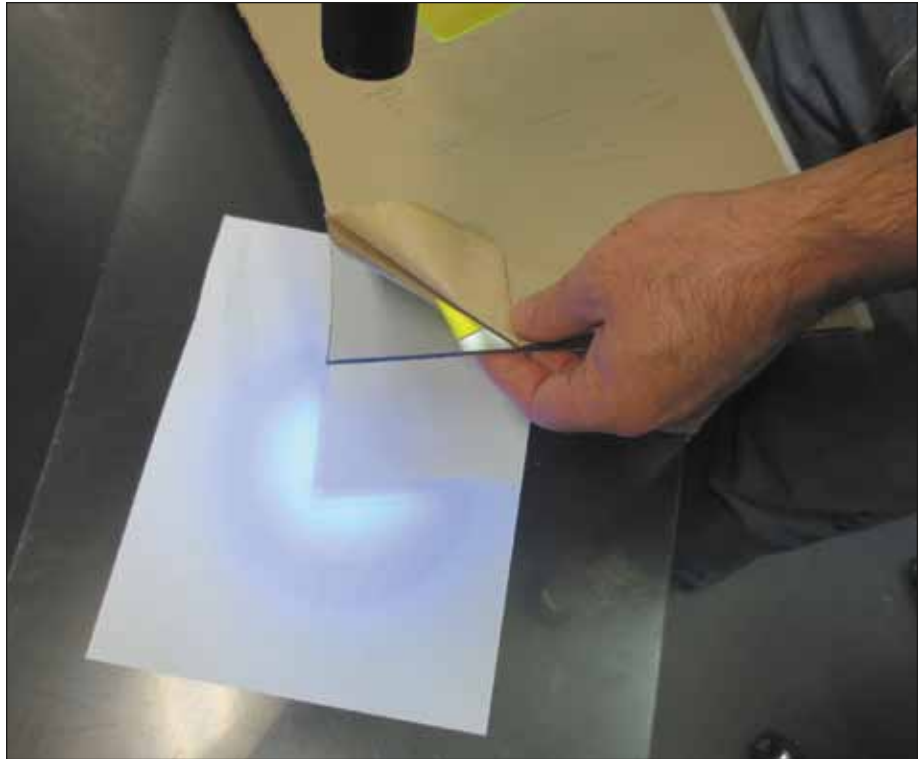
We were told in no uncertain terms that most difficult glass work is on composite aircraft—particularly on the Cessna 350 and 400. An owner should figure on 100 hours for the windshield and 40 for each side window. The glass is put in place from the outside, the special glue used has to be heated and then kept at temperature for several hours, and cosmetic work including body filler has to be done and the area painted.

We did not hear any good words about the painting process and trying to match colors on an airplane with no seams.

On the other hand, the Cirrus series, although composite, has glass that is fairly easy to replace for new airplanes. It is replaced from the inside—no painting is involved.

We did hear some unpleasant stories of inexperienced shops and ham-fisted technicians that either spent an inordinate amount of time on installations, did them poorly or couldn't do them at all. Our suggestion is to make sure your shop has installed glass on the type of airplane you own before you have them do yours.

The shops we spoke with said that



when they had questions, the manufacturers were very helpful in answering.

CARE

Whether you are dealing with new replacement glass or your existing acrylic, the care is the same. Do not use any harsh chemicals or ammonia-based cleaners when cleaning the acrylic—we heard horror stories of people who used lacquer thinner, wood alcohol and abrasives and then wondered why their windows were nearly opaque.

The manufacturers recommended mild dish soap (we heard Dawn mentioned) mixed with water and rubbing the window with one's bare hand (no jewelry) as the best method. If a cloth is used, it should be soft and non-abrasive. 3M cleaning products were spoken of positively. We recommend the manufacturers' websites as they have excellent information on cleaning and protection.

COVERS AND SHIELDS

For protecting the windows and windshield, some shops we spoke with liked external covers; others spoke ill of them. Everyone agreed that if used, they have to be tight and keep dust out. A cover flapping in the wind will damage acrylic quickly, especially if there is any dust under

it. The chemicals used to bond the interior material to the outside cover of some will migrate through the cloth to the acrylic and damage it. Sewn rather than bonded covers were recommended.

We also received conflicting recommendations on sunshields. Some told us that they hasten acrylic deterioration because the UV rays go through the glass and then are reflected back out, doubling the effect. Shades should not have any metal surfaces that come into contact with the acrylic.

CONCLUSION

Window and windshield replacement is a fact of life for aircraft owners who cannot hangar their airplanes. The price of the replacement glass is almost always less than the cost of the labor for the replacement—so the savings gained in selecting a shop that has experience doing the work on your type of airplane may allow you to buy UV- and IR- radiation blocking acrylic and could pay off in a longer life for the interior and you. We think the benefits of an exterior cover or interior window shields exceed the risk—just make sure your cover doesn't flap or have dust under it and that your window shields don't have anything metallic touching the acrylic.



Airworthy Autogas: Will Mogas Fly This Time?

By blending mogas to meet Lycoming's SI 1070, Airworthy hopes to overcome bias against car gas and carve out a significant market.

by Paul Bertorelli

The notion that ordinary automotive pump gas can be a cheaper alternative to increasingly expensive avgas has had a rough time of it. Mogas gained traction during the 1980s and saw wide enough distribution to be a player, but a shrinking price Delta against avgas, a cold shoulder from the engine manufacturers and a rising flood of ethanol has stunted the mogas movement.

Now, a company called Airworthy




Autogas wants to make another run at the market with a boutique blend of mogas designed to forthrightly address three complaints about pump gas intended for cars: lack of assured octane, a guarantee of zero ethanol and satisfying beefs raised by the engine manufacturers about both.

The critical piece of the mogas puzzle is price. Airworthy Autogas is sure its product will be cheaper than avgas, but it's not sure how much cheaper and it won't know that until

production is stabilized and with a few months of history.

A 50-cent price Delta might not be enough to lure owners into buying the necessary STCs and/or convincing FBOs to install the tankage. But this new product has at least one thing going for it: It meets the specs of Lycoming's SI 1070 and thus,

CHECKLIST

-  Airworthy's specs guarantee 93 octane and vapor pressures close to avgas.
-  Premium BOB feedstock is widely available at terminals.
-  FBOs are still chilly to the idea of dual fuel installations. Branding is also an issue.

for the first time, has the blessing of an engine manufacturer.

WHAT IS THIS STUFF?

Airworthy Autogas is the brainchild of several fuel executives including Mark Ellery and a business offshoot of CalJet of America, a major fuel blender and terminal in Phoenix. (Airworthy Autogas is an independent company.)

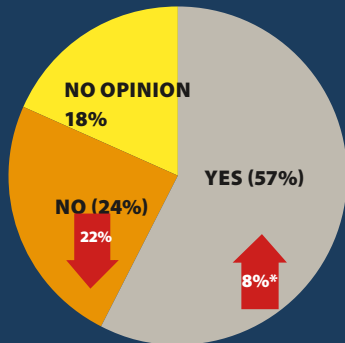
CalJet's Phoenix facility is the sort of terminal found all over the country, at the terminus of pipelines delivering both finished fuels and what's called blendstock for oxygenate blending, or BOBs. Because ethanol is too corrosive to be delivered via pipeline, it's blended into BOBs at the terminals before being

Airworthy's facility in Phoenix, top, consists of storage tanks and blending units. As a demonstration project, the company flew a Piper Archer on Airworthy Autogas to AirVenture in July 2013.



READERS ON MOGAS: WARMING TO THE IDEA

Would you consider using mogas in your airplane?



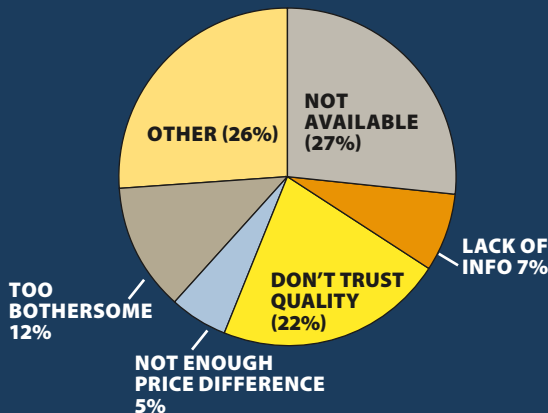
*Change in opinion since 2011.

If you're a believer in market timing, Airworthy Autogas could be in the midst of a perception shift in favor of mogas, if the survey data shown here is accurate.

We asked readers of our sister online publication, *avweb.com*, for their views on avgas and mogas in August of 2013, repeating a survey we performed in 2011.

As the graphics show, there seems to be a measurable shift in owners and pilots willing to use mogas in their aircraft. Note that those who would consider mogas increased by 8 percent to 57 percent and those who say they wouldn't consider it dropped by a whopping 22 percent. Some of

Why haven't you considered mogas?

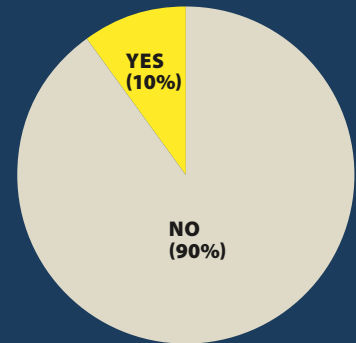


this variation may be due to random sampling error in the survey, but we still suspect there's an opinion shift afoot.

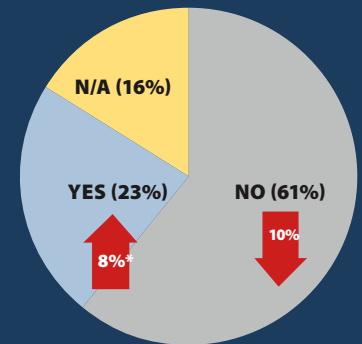
Interestingly, when readers are asked why they haven't tried mogas, lack of a price difference against avgas doesn't appear to be much of a factor. Only 5 percent said this was true for them. Lack of availability and worries about fuel quality are larger negative drivers, according to our survey.

Still, some hold negative opinions of mogas for various reasons. "As an AME / A&P, I don't see autofuel as an option. It works okay if you fly regularly (more than once a week), but this does not represent the reality of recreational

Is mogas available on your airport?



Have you asked your FBO to carry mogas?



aviation today. Let avgas sit in your airplane and you will have problems," said Jeffrey Pyefinch. But others say problems are overstated. "I've used auto fuel in my Cessna 150G since 1986 and use it in my Cessna 172A now. Have never had a single problem in doing so," said Robert Fitzsimmons.

delivered to distributors or retailers as finished fuel. Because a shot of ethanol—up to 10 percent—increases octane, BOBs are delivered octane deficient, except for the small volume of E0 fuels intended for the marine, RV and sporting markets. This includes premium BOBs, whose final octane is also set by the addition of ethanol.

Ellery told us that Airworthy Autogas is run-of-the-pipeline premium BOB to which the company will add a proprietary additive package to guarantee a minimum octane of 93 and Reid vapor pressures more in line with certified avgas or no higher than 9 PSI.

In the boutique fuels market—and Airworthy Autogas will certainly be one of those—transportation can be a deal breaker. The volumes are too

small for pipeline transport and the next best alternative, rail car, may be too expensive if the price difference against avgas isn't high enough.

Ellery says the company's solution to this is to transport the finished fuel to a market only within 400 to 500 miles of Phoenix, for which it has a dedicated fleet of 50 tanker trucks. For markets beyond that radius, Airworthy intends to "cut and paste" the blending technology to other terminals around the country that are, presumably, closer to the final markets.

The capital required to do this, while not trivial, involves little more than tank farm and blending facilities. The remainder of the problem is simply truck transportation to local or regional markets. Because Airworthy Autogas is an unleaded fuel,

it won't require segregated tanker trucks, as 100LL now does, further reducing transportation costs.

Airworthy Autogas meets the ASTM D-4814 standard that describes virtually all of the automotive fuel sold in the U.S., but it tightens up two critical specs that Lycoming lists in its SI 1070 bulletin approving a range of engines for mogas use. At 93 octane, Airworthy meets SI 1070, but exceeds the actual octane requirement for most low-compression engines that could burn it. More critical is Reid vapor pressure. To prevent vapor lock in engines taken to high altitude, the ASTM D-910 spec for avgas calls for vapor pressures between 5.5 and 7.1 PSI. Airworthy is aiming for under 9 PSI, compared to values as high as 12 PSI for automotive gasolines.



To keep transportation costs reasonable, Airworthy will deliver fuel regionally using its own fleet of tanker trucks.

"We're not using anything that refiners haven't used in years gone by, but we're just doing it in a different manner," Ellery says. As for volume, Airworthy's new facility in Phoenix is designed to have sufficient capacity for a regional market. "When we go online, we will have sufficient volume to serve the entire U.S. Southwest region, including southern California," Ellery adds.

WHERE'S THE MARKET?

Although our surveys—including the most recent summarized on page 13—show wide interest in mogas, there's not much of it around on airports. Only about 115 airports have mogas pumps, with a strong concentration of airports in the Midwest. We hear conflicting reports about how much non-ethanol premium mogas is available at terminals for distribution at airports willing to install the tankage. But Todd Petersen, whose Petersen Aviation developed and still sells the original 1980s autogas STCs, says that at least the perception of difficult E0 supplies has diminished interest in mogas. For the past couple of years, STC sales have picked up a bit, but mostly in the European market where avgas costs twice as much as it does in the U.S.

Airworthy's Ellery told us he's aware of the supply issues and rather than attempt widespread distribution of Airworthy Autogas, the company will aim first for the flight training market around Phoenix and possibly in Florida.

Even at that, Airworthy knows that two significant barriers to mogas uptake remain, one obvious and one not so obvious.

With the exception of FBOs that have already adopted mogas, the U.S. FBO market has been distinctly chilly toward installing tankage for a second gasoline. That was one reason that 80/87 avgas was phased out in favor of the single compromise product that became 100LL. Ellery said Airworthy might be amenable to installing or leasing tanks, if that's what it takes.

"We don't want to be vertically integrated. The last thing I want to do is become an FBO. But I'd be more than happy to work with an FBO facing the infrastructure problem," Ellery said. This sort of business model—with tanks installed and owned by the fuel provider—is more common in Europe.

Brand contracts are another barrier. "I can't tell you the walls I run into immediately when I knock on the door of an FBO. If they're branded with a refiner, they slam the door on you. They're not allowed to have a competing fuel," Ellery said. And that extends to competition that isn't another brand of avgas.

IS THIS DOABLE?

To answer that question, we reviewed Airworthy's plans with both Todd Petersen and fuels chemist Ed Kollin, who's working on his own additive project to produce an unleaded 100-octane fuel.

Kollin still sees vapor pressure as an issue, because vapor pressure is driven down by light or volatile fractions that evaporate as the fuel ages. There's also some octane loss due to that process. But he concedes the octane issue might not be real for carbureted engines that don't require the full 91 or 93 octane, and according to Petersen's STC list, that's a large number. Furthermore, although four engine groups on Lycoming's SI 1070 list are fuel

injected, only a couple of Petersen's approvals cover fuel-injected engines. Fuel-injected engines can be more susceptible to vapor pressure-related issues because injection pumps can cavitate due to vapor lock.

Still, Petersen says he's happy to see Airworthy Autogas's introduction and if it succeeds, he'll expect to sell more autogas STCs. Lycoming's approvals apply just to the engines; the airframe also requires an approval and Petersen sells both.

"It'll be great if they're able to get this installed," Petersen said of Airworthy's efforts. "Just getting a reliable source of no-ethanol gas has been a persistent problem," he adds.

"When Lycoming approved D-4814 autogas, I took that to be an endorsement of the basic autogas. They are specifying a little lower vapor pressure and a higher octane, but when it comes to the core components of it, it's the same," Petersen says.

CONCLUSION

Although critics of autogas insist that vapor pressures in the range of typical autofuel will lead to accidents, we don't see a record of that in the NTSB's files. In fact, there are few accidents at all in which autogas or mogas—we use the terms interchangeably—are even mentioned.

We think Airworthy Autogas's major challenge is not technical, but in marketing and distribution. If, through effective marketing, it can convince owners to drop what appear to be unfounded biases against avgas, it could very well make inroads. It's widely assumed that whatever fuel replaces 100LL will cost more than the \$6 average national cost in October of 2013. If that turns out to be true, Airworthy Autogas could sell for \$1.50 or so less than unleaded 100-octane avgas. Could that entice enough pilots to start buying it and asking FBOs to carry it? Mark Ellery is counting on it.

CONTACTS

Airworthy Autogas
602-296-6183
www.airworthyautogas.com

Jeppesen FliteDeck 2.1: Simple Flight Planning

Jeppesen finally adds own-ship, NEXRAD weather and automatic taxi diagrams to its IFR app. Data-driven charting means less pilot interaction.

by Larry Anglisano

In a world where aviation apps are overloaded with features, Jeppesen believes that pilots should spend more time flying and less time operating their iPad. As a result, they've reworked the user interface on the FliteDeck app so that it's based more around an IFR pilot's workflow and requires less hunting for information.

Many of the enhancements to Mobile FliteDeck 2.1 is the result of

feedback received from professional pilots. The short list includes limited features we might expect from a modern aviation app, including own-ship position on charts, automatic transition to the taxi diagram upon landing and the ability to view charts before you load them.

BORN FROM VFR

Jeppesen's IFR Mobile FliteDeck (and even the FliteDeck Pro app for commercial and military applications) originated from and retains many of the straight-forward functions found in the FliteDeck VFR app. The result is an app that's designed for limited pilot interaction. One concept that carries over from the VFR app is data-driven charting.

Jeppesen is quick to point out that data-driven charts are not PDFs of a paper chart. Instead, charting and mapping is

CHECKLIST



A refreshingly basic, useful app that's free with a Jepp chart subscription.



Data-driven charting reduces pilot interaction and enables customizing.



An ADS-B interface would add FIS weather. It's missing and so is a Droid version.

automatically rendered based upon your position. For instance, the area maps and airport diagrams are displayed in a single view, without the user having to toggle between two separate maps to work with them.

The other benefit of auto rendering data, rather than using a static onscreen PDF, is the ability to customize the view. This means you can remove sizable amounts of data that you don't want to see. Don't want to see airports on the enroute chart, for example? Data-driven charts enable you to turn them off.

SMART, BASIC PLANNING

You won't find much glaresfield candy in Mobile FliteDeck (that's the term we use for apps that enable fancy synthetic vision and flight displays). Instead, the Jeppesen app is all business—excelling, in our view—at straight-forward flight planning and the ability to find the data you want quickly and easily.

Jeppesen added enroute weather data to the app, including icing, radar, turbulence and winds aloft, but weather overlay requires an internet connection, limiting weather to ground planning only, in most cases.

The NEXRAD radar can be animated and the system checks for weather updates every 6 minutes. Terminal weather, including METARs and TAFs, are accessible when you call up a terminal chart for the selected airport, or in the apps enroute view, through airport popovers.



We think the Jeppesen Mobile FliteDeck's onscreen presentation and flight planning is about as simple as it gets. It's easy to remove features from the enroute map, left, while pinch zooming and rubber banding results in fast redraws.



Approach charts, left, are intuitive to access, thanks to a dedicated approach chart tab on the left side of the display. You can view the chart and then store it for later access in an electronic chart clip. We drew the green circle on this chart with a finger, using the highlighter tool. It's useful for making and easily erasing notes.

Some users might ding the app for not having the layers of gee-whiz functionality you'd find in other apps, but that's not what Jeppesen set out to do. Instead, it's all about utility and easily creating a flight plan.

One easy way of creating a flight plan route is to open what's called the route drawer. Simply enter the origin, destination and as many alternates as you wish (these alternates are highlighted on the map). Close the route drawer and a great circle route between the origin and destination airport is displayed. Next, enter the route points in the route box. You can also add a SID and STAR to that route string. We found that an easy way to transfer the route points was to paste an existing flight plan route that was previously entered in the iPad notepad.

Another way to add routes is by importing them from Jeppesen's FlitePlan Online. Once you enter the FPO account in the device's global settings, an import button automatically appears in

the route drawer. Tap it and select the route you want to add.

We think FliteDeck makes rerouting easy. To add a waypoint to the route, you can tap the search button, where you then enter characters into the search field. The app orders the search results nearest to farthest, from either the chart center or the aircraft position. When you find the object you want, tap the Add to Route key or set it as the new destination.

You can also edit the route by tapping on the object you want to remove, and select the Remove From Route command. You can view the route that's overlaid over the Low or High enroute maps in either north up or track up configurations, by pressing the onscreen compass rose button.

CHARTING, RANGE RINGS

New to version 2.1 is a chart selection and chart clip function. This gives the user the ability to preview a chart and then add it to a so-called chart clip at the bottom of the screen. Using a two-finger swipe, you can pan across all of the charts that were added to the chart clip.

You can also access a different chart group for the selected airport, including SIDs, STARs and taxi charts, from a dedicated chart group menu that lives on the left side of the screen.

Charts can be rotated by tapping a Rotate button on the right side of the display. Each tap of the Rotate button rotates the chart 90 degrees clockwise

Also new to version 2.1 is the display of own-ship on the approach chart, in addition to an off-map indicator. When the own-ship is within 10 nautical miles of the chart area, you will see an onscreen indicator, showing the position and the area from which you are approaching. When you land, the taxi chart automatically appears, based on a preset groundspeed trigger.

The distance measurement tool is a set of range rings on the map that depict the approximate distance of the own-ship from objects on the map. What's nice about this, in our view, is that the range rings automatically readjust, based on the map zoom level.

JEPP'S GIFT TO YOU

Think of Mobile FliteDeck as an extension of the Jeppesen charting subscription—or Jeppesen's way of throwing users a bone for subscribing to their data service. We think Mobile FliteDeck would be more complete—and competitive—if it could display ADS-B weather and traffic. This would require an interface with one of the many ADS-B receivers on the market, an interface Jeppesen says they are planning.

Mobile FliteDeck includes enroute charts, VFR and IFR terminal charts and airport diagrams, in addition to Jeppesen's Airway Manual text data. The application can be used as a paper-replacement solution for RNAV-equipped aircraft.

Any JeppView 3, Express JeppView, JeppView MFD or NavSuite chart subscription allows you to download this data, free of charge, into the Mobile FliteDeck application as long as you have a valid site key. The app can be downloaded from the Apple App Store and is compatible with the iPad 2 and iPad 3. Jeppesen says it is evaluating non-iOS compatibility, but the final decision will depend on user demand. Visit www.jeppesen.com.



MotoPOD: Motorcycle On The Fly

Who thought you could easily load a street-legal motorcycle into the cabin of a small Piper? You can with MotoPOD's MotoLOAD system.

by Larry Anglisano

If for no other reason than adventure, flying and motorcycling are crossover sports. But that's not the reason why MotoPOD founder and engineer David Shelton invented the MotoLOAD—a series of ramps and fixtures that allow pilots to load and secure an aviation-specific 225-cc motorcycle inside the cabin of a Piper Cherokee Six, Lance, Saratoga or Seneca.

Instead, it's the inconvenience of arranging for ground transportation once you land at your destination that created the idea. According to Shelton, only one-third of public airports have easily accessible ground transportation. This is one reason why Shelton believes that personal airplanes are drastically underutilized.

Bring your own motorized ground transportation at every single air-

port. That's the concept that sparked the idea of the MotoLOAD system. The motorcycle loading and storage system is only for Piper applications, but the company is working on a system that will fit the Beech Bonanza, Baron and Cessna 206.

SEEING IS BELIEVING

We expected to see MotoPOD's idea of a motorcycle to be some puny scooter or motorized bicycle (no disrespect to the riders of these cycles, but we're critical sport bike and sport tourer jocks). Instead, the system uses a custom-modified 225cc motorcycle that the company calls the MotoCYCLE. For those not versed with street-legal motorcycles, a 225cc bike won't break any speed records, but it's no slouch, either. The company says the bike is highway-safe and has a top speed of 85

CHECKLIST



MotoPOD solves the dilemma of finding ground transportation.



You can likely carry full fuel, one passenger and the motorcycle in a PA34.



Pack light. The MotoCYCLE is far from a sport touring bike.

MPH. It's also capable of two-up riding, which means you can carry a companion. Don't forget to bring a backpack for the destination because that's all you'll be able to bring along once you put a leg over.

The 220-pound MotoCYCLE is designed for reliability and safe air transport. It's modified around a Yamaha XT-225 frame and engine and has a modified fuel and oil system that's spill-proof. The fuel tank is fitted with a venting system that's appropriate for cabin altitude. This eliminates having to drain the fluids before loading the motorcycle into the aircraft. MotoPOD can provide a motorcycle, modify a customer's motorcycle or they can help customers locate a used or new motorcycle. Each motorcycle is fitted with custom graphics to match the paint scheme of the aircraft.

MOD IT—TO LOAD IT

To fit the motorcycle into the cabin, the handlebars and foot pegs are folded and the center stand is removed. But there's far more tweaking involved to get the system to fit in a small cabin.

The modification includes replacing both the front and rear wheels on the motorcycle with smaller ones to obtain a smaller overall footprint.

That's a highly modified Yamaha XT-225 street-legal motorcycle and loading system, left. Both are designed to fit through the rear door and stow in the rear cabin of a Seneca, Saratoga, Lance and Cherokee Six. Together, the entire system weighs 325 pounds.





Don't plan on loading passengers into the rear cabin of your Piper—the 95-pound MotoLOAD system occupies most of it, top left photo. We think the loading hardware, middle photo, is made well and the cordless drill-driven winch system makes for speedy loading and unloading. The company also builds custom exterior storage pods, bottom photo, for carrying the MotoCYCLE or other gear.



The suspension is lowered and carbon fiber fenders are installed to reduce

the overall weight.

When it's folded, the motorcycle measures 12 x 64 x 34 inches. Shelton told us that other "real" motorcycles can't be modified to work with the MotoLOAD system, given the level of modification that's performed to the Yamaha XT-225.

FLY TO RIDE

MotoPOD says the entire system can be loaded or unloaded in just a couple of minutes. First, the motorcycle is loaded onto a rolling sled, where it sits in fiberglass cradles. The sled is tipped to the horizontal position and then winched up a ramp and into the rear passenger door. The system has a built-in winch that's powered by a cordless drill.

Once inside the aircraft, a pivot board swings the motorcycle into the cabin, where it's positioned into the foot well. The system is secured into place using an integral tie-down system that uses a combination of ratcheting straps (manufactured by Hooker Harness).

These straps attach to the existing seat belt buckles.

Removing the bike, says MotoPOD, can be accomplished in 90 seconds. You simply winch the system back out of the cabin, unfold the handlebars, unload the bike from the sled and ride away.

For most PA-32 and PA-34 aircraft, you can carry the loading system, the

motorcycle, two average-sized adults, full fuel and a bit of luggage.

STORAGE OPTIONS

MotoPOD builds custom belly pods, made from composite materials and can accommodate cargo up to 8 feet long. Where conventional pods are loaded through a small hatch, the MotoPOD is loaded from the top. This makes it easier to load a bicycle or other large items. The external pod—that can fit on the belly of a Van's RV and Cirrus SR22, to name a couple of applications—has an empty weight of 50 pounds and a gross weight of 250 pounds. Expect a speed penalty of approximately 9 knots.

The belly pod allows you to carry the MotoCYCLE (with front wheel removed), using removable cradles that attach to the floor of the pod using thumbscrews. Pods can be customized to carry camera equipment, antennas and other special-mission gear. Pricing is based on custom configuration. The company obtains FAA approval on a case-by-case basis.

The MotoPOD and MotoLOAD system, including the motorcycle, starts at \$15,000. While this isn't cheap, Shelton is convinced that the right customer will enjoy the benefits of an expanded mission.

"To put it in perspective, \$15,000 includes a custom aviation motorcycle and a seamless loading system for about the cost of an average Harley. Based on the time savings, it's the ultimate speed mod."



CONTACTS

MotoPOD, LLC
847-651-4373
www.motorcyclepilot.com



Avionics Outlook: Competition, Lower Costs

If the Part 23 rewrite doesn't lower costs, the struggling market might have to rely on increased competition and simpler products to get it done.

by Larry Anglisano

What will it take to stimulate a flat avionics retrofit market? There are buyers, by the way. It's just that fewer of them are willing to slap \$40,000 on the counter at the avionics shop like they did 10 years ago. Today, \$20,000 is the new sweet spot for a modest upgrade. For many, that's a stretch.

Any shop is happy to close a \$20,000 deal but you can bet they'll work hard to do so. That's because it's difficult to convince skeptical buyers to drop that kind of dough on certified avionics when they're already sold on a \$300 iPad that's loaded with a variety of flight planning, navigation and flight instrument apps.

As we look into our crystal ball for the upcoming new year, we spoke with the management from Garmin, Bendix King and Aspen Avionics to get a feel for how the FAA's Part 23 rewrite, increased competition and low-cost consumer tablets might change an avionics market that's tired of the high prices and the complexity of certified equipment.

RELAXING PART 23

While a rewrite of Part 23, the FAA design and certification standard

for light aircraft, might not be the pot of gold at the end of the financial rainbow, every manufacturer we spoke with agreed that it can lower costs while also reducing the amount of time it takes to certify new products. While it's tough to

MARKET ANALYSIS

say just how much prices could drop, we've heard speculation from as little as 10 percent to as much as 25 percent.

In a nutshell, the Part 23 revisions are aimed at making the certification process easier while allowing easier incorporation of new technologies in certified aircraft (read uncertified avionics). The standard sets up a system of compliance through consensus-based standards.

GAMA President Pete Bunce told sister publication AVweb.com something that everyone can agree on: Changes to Part 23 are needed.

"When you can go and put modern equipment into an amateur-built aircraft and have it perform just tremendously well, but then it costs 10 times as much to be able to put that into a certified airplane, our regulatory process is defeating

the purpose for which it was set up, and that's to enhance safety," said Bunce.

The key here is to lower certification costs by reducing the amount of time a product sits in the development and certification process. But will manufacturers pass along these savings to the end user? That's exactly what we asked Garmin's Jim Alpiser, who assured us that his company will pass along the savings.

"The customer is going to get that savings. The less time it takes to get a product to market, the less it costs to develop it. That translates into savings for customers. The other aspect is that our competitors are out there keeping us honest. The competitive nature of the market is the self-policing part of this," said Alpiser.

Worried about a slip in quality? According to Alpiser, even with a relaxed Part 23 standard, Garmin is committed to a high level of product testing. The company made a multi-million-dollar investment in environmental test equipment to ensure that its certified products exceed FAA requirements.

Alpiser acknowledged that if Part 23 rules relax enough, competitors with non-certified equipment

will make a serious run at certified aircraft. In our view, that alone is enough to keep a company honest, from a price and feature standpoint.

Despite the high cost of certified equipment, it's important to acknowledge that avionics equipment prices haven't, in general, been increasing, given the down market. That can't be said of the costs of new aircraft, which continue to increase.

OPEN ARCHITECTURE

Aspen Avionics' Jon Uczekaj believes that competition and systems with open architecture (basically, cross-brand compatibility) is the biggest factor in lowering prices. According to Uczekaj, firms with both innovative products and innovative approaches to marketing cast a level of confidence in the consumer that they don't have to buy one

brand of product to get a complete interface. In the consumer's mind, a product's inability to play in a cross-brand interface becomes a question of ethics, in our view.

"The media plays a big role in drawing this issue into the public because it creates dialogue, reaction and makes for a smarter consumer. As a result, companies will ultimately take the steps to create an open architecture," said Uczekaj.

Fingers have recently been pointed at Garmin—a company that once excelled in building open interfaces—for not playing well with others. Garmin's Alpisier says the company is careful about being tied to a third-party interface and its potential for stifling future product enhancements.

"Our competition and some people in the industry are saying that Garmin is locking everyone out. That's not the case. We don't want to offer customers the disservice of offering a public interface that changes a year down the road," explained Alpisier. Garmin isn't always to blame.

In the past, companies have reversed/backdoor-engineered some of Garmin's GNS430 and GNS530 interface potential (including Garmin's popular RS232 data crossfill interface) to add unapproved enhancements and compatibility. While this is no fault of Garmin, the blame ultimately falls on Garmin for not recognizing—or killing—the interface with new software and hardware updates.

We predict that this problem could get worse as new ADS-B products come to market. It will be up to the shops to advise owners of the risks associated with unapproved interfaces. In some cases, it could alter the

airworthiness of a system.

It would appear that Bendix King embraces the open architecture concept, evident by the flexible interconnect capability of the new KSN770 navigator (we evaluated the KSN770 in the October 2013 issue of *Aviation Consumer*).

On the topic of the KSN770, an interesting aspect of its final development was a partnership between Bendix King and Aspen Avionics. While Bendix King designed the hardware, it was Aspen that completed the user interface. According to Bendix King's Roger Jollis, expect to see more of this collaboration moving forward.

"This industry is too small to do everything alone. We're identifying partners where we can add synergy while bringing products to the market more quickly and less expensively. We think this approach is healthy for the industry," said Jollis.

Bendix King recently introduced the KT74 ADS-B transponder—a unit with a Trig Avionics back end.

THE NEXT MEGA-SYSTEM

While products like Garmin's G1000 have a major presence in OEM applications, it's not a system that evolved into a widespread retrofit platform, given the level of required airframe interfacing and installation costs. The way we see it, there's a need for a significantly less expensive replacement for legacy products found in older aircraft. By this, we're talking about a replacement for the G1000 that's easier and more affordable to retrofit. Perhaps a single box that can do it all—everything from VHF radios, MFD, ADS-B and engine display. Garmin's Alpisier doesn't think it's practical from an engineering standpoint.

"There's so much going on in that kind of single box that overcoming the challenges of separating harmful interferences, for example, can be a hurdle," noted Alpisier.

On the other hand, Alpisier thinks the market for such a box exists, but

Apple's iPad, portable AHARS, and Garmin's G3X integrated avionics suite, left. It's uncertified and capable products like these that add a stinging effect to the cost of certified avionics. The FAA's Part 23 revision could give these products longer legs.



questions the value of older airframes for such a product. Still, it's an area of focus for Garmin, moving forward. In fact, we don't believe for a second that Garmin isn't working on such a box.

Don't count on a mega system from Bendix King in the near future. It has its sights on legacy upgrades. Remember, when Bendix King announced its return to the market, it vowed to bring to market products that were simple to use and affordable—something we haven't seen from them yet. The way we see it, there's a huge number of aircraft that sport digital KX155 and even mechanical KX170B radios that might benefit from modern replacements. Many of these owners want a simple installation that requires a small investment.

"We have taken the decision to focus on the retrofit panel market because the volume coming out of the OEM market is substantially low. There are lots of aircraft that need to be retrofitted, and owners might not be able to spend tens of thousands of dollars to do so. Plus, it might not even be feasible to install an integrated system in some of these aircraft," said Bendix King's Roger Jollis.

"One of our brand promises is to make our products the most intuitive to use. You shouldn't need to read a manual," added Jollis.

Jollis noted that the average demographic of the Bendix King customer is 57 years old and aging rapidly, noting that small flickering text, the complexity of the interface and operating a FMS may not be safe to fly if you don't operate them all the time.

On the other hand, we wonder if any company can compete with a simple system. Tablet apps compete on the notion of advanced functionality because buyers love gadgets.

Aspen's Uczekaj believes there is still a demand for a retrofit megabox—the next G1000, perhaps—if it meets the sweet spot on price and installation complexity. As for the time frame, Uczekaj believes that five years isn't an unreasonable expectation to see such a product. He also stressed that customers should be given the option to buy into an entry-level system that has an easy upgrade platform—something the Aspen Evolution PFD does. The current entry-level system from Aspen

BENDIX KING: THE TRUST FACTOR

For an avionics company, the dealer network is the ultimate selling tool. Avionics shops are used to a market that's dominated by a diverse Garmin product line and an aggressive sales force. It's fair to say that Bendix King dealers aren't preprogrammed to recommend Bendix King products. The company is destined to fix that, with several new recent product introductions, including the KSN770 retrofit navigator, an ADS-B transponder and a non-certified angle of attack system. There's also a tablet app and PS Engineering's 8000-series audio panel that wears the Bendix King logo.

These products are a good start, in our view, but we have to wonder if it's enough to convince a skeptical dealer network that Bendix King is serious about gaining the lead it once had in the industry and, more importantly, that it is here to stay.

We spoke with several avionics shops to better understand how they embrace Bendix King's return to market. The response was lukewarm, if not skeptical. Interestingly, none agreed to put their comments on record. We're not surprised. After all, shops still rely on their Bendix King dealership to obtain service parts for repairing legacy King products, including KX155 navcomm displays and other Silver Crown service parts.

"Those guys will never be at Garmin's level; they don't have a big

enough product line; the KSN770 isn't the inexpensive product they promised," were just a few of the comments we heard.

How can Bendix King get dealers back on board? By continuing to do what Bendix King president Kevin Gould is doing: engage the dealer network by visiting with shops to hear their concerns. He's also reinstated the dealer advisory council. This is where dealers visit Bendix King headquarters to offer feedback and to see first hand what the company is doing. We saw a busy Bendix King and a passionate team during our recent visit to their Albuquerque, NM, flight test center.

Unfortunately for Bendix King, dealers may overlook the new KSN770 in favor of Garmin's GTN750 despite the KSN770's lower price and hybrid feature set. The KSN770 can also be an easier installation given its smaller footprint, compared to the GTN750.

Bendix King is making an effort to educate dealers on these specifics and how to qualify buyers. Still, dealers need more products to sell. While there are still some legacy products available, Bendix King doesn't have the slew of leading-edge products that have high customer value, as initially promised.

"The trust factor is something we have to earn back. We need to prove this to our dealers through our actions. In the near term, it's going to be an uphill battle," Gould told us.





The panel of this Grumman Tiger, left, represents the so-called federated retrofit. A megasystem install like the Garmin G1000 isn't possible or practical but like many aircraft, it needs an affordable, modern upgrade.

is a single PFD that can be upgraded to a three-screen suite with synthetic vision, charts and satellite weather. Aspen has reached 6000-plus installations.

Even with the presence of the next mega system, whatever it may be, the industry buzz word is "federated." These are modern but individual components to replace aged ones (navcomms and transponders, for example).

TRICKLE-DOWN SAVINGS

It's easy to say that consumer tablets, particularly ones that connect with portable AHARS systems, will take over the IFR cockpit with some level of certification, but we're not buying it. The iPad, for example, continues to prove that it has sizable limitations when it comes to heat, screen glare and the potential for program lock-up. The same can be said for portable GPS navigators, for different reasons, even in a world with a relaxed Part 23.

What they will do, in our estimation, is supplement and complement panel avionics on a higher level. Expect to see more advances in Aspen's Connected Panel—a wireless connection between the tablet and panel-

C H E C K L I S T



Competition could birth niche markets and more buying choices.



Relaxed FAA certification could open the market to non-certified avionics.



Forget consumer tablets for primary. Hardware still isn't robust enough.

mounted equipment.

Garmin makes it clear that as capable as its flagship portable—the aera796—is, this product has not been built to the

standards that it thinks is necessary for IFR flying. These kinds of tests include vibration, lightning suppression and high-energy interference testing, to name a few.

On the other hand, products like the uncertified Garmin G3X, including its ADAHRS, have undergone a higher level of testing.

As we reported in the May 2013 issue of *Aviation Consumer*, the redesigned G3X is aimed at LSA and experimental aircraft applications and is available with an advanced digital autopilot. In our estimation, we see few if any reasons why a platform like the G3X—or systems like the Dynon Skyview integrated avionics suite—wouldn't have enough built-in failsafe functionality for IFR flying in Part 23 aircraft. It's this concept and products like these that can be a game-changer in a relaxed Part 23 environment.

Still, don't underestimate the role of consumer electronics in reducing product costs. Whether it's processors or glass display technology, variants of these components are starting to appear in certified products and are reducing the build costs.

"While we use a different class of component in certified avionics than what's found in most consumer electronics, there is a drive downward on the costs of components used in consumer electronics. This helps to reduce the cost of certified components," said Bendix King's Jollis.

Aspen's Uczekaj echoed the consumer product trickle-down cost savings.

"It used to be that glass was the most expensive component in a glass cockpit suite. It's no longer the case," he said.

Another way to reduce equipment costs is to offer products with lesser

capability. It can be argued that the \$17,995 Garmin GTN750 is, based on its features, a good value. But for the buyer who doesn't want all of its features, not so much. This is a niche that Bendix King's \$12,995 KSN770 might fill. We like Aspen's philosophy of offering scaled-back products that can be added to as the budget permits and missions change.

A WILLING MARKET

Moving forward, expect avionics manufacturers to be bullish, no matter what niche they pursue. You can also expect more competition on the shop level, with high-volume shops dominating. It's clear that Garmin, Aspen and Bendix King believe that the market is robust enough to support increased competition.

According to Bendix King, there are somewhere between 250,000 and 300,000 general aviation fixed-wing aircraft in the world. About one-third of these aircraft have hull values less than \$50,000, while another one-third of them have hull values between \$50,000 and \$100,000.

These two price-sensitive segments think twice about the large investment of major avionics upgrades. While this segment has recently been served by Garmin, we think Bendix King—with the right products—can dominate that market as they once did with their Silver Crown line.

Looking into our crystal ball, we see growth and increased competition in the avionics market—which is good for the consumer. But even with increased competition, we still see a market that will continue to be dominated by a remarkably innovative Garmin. We're not alone.

As Aspen's Uczekaj put it: "Is Garmin still a big player? Absolutely. That's why it's important to develop a niche market because if a smaller company like Aspen tries to go head to head with Garmin, they'll lose."

Paul Bertorelli conducted some of the interviews for this article at AirVenture 2013.



The Trans-Ind mounts to the glareshield with Velcro, left photo, or can function as a handheld, lower right. The yellow LED indicates transmit carrier and the blue LED indicates modulation.

Trans-Ind TX Indicator: Portable Comm Tester

A VHF radio frequency detector that monitors your comm transmissions. It's simple and cheap.

by Larry Anglisano

Is my radio transmitter working? At some point, that's the question nearly every pilot will ponder when they check in on a frequency and get no reply. Most of the time, the radio is functioning properly, but other times it's a real-world failure.

Electrical Efficiency Systems designed the \$190 Trans-Ind radio transmitter monitor to take the guesswork out of these situations. It's a portable unit that listens for radio transmit and voice modulation and displays the status using simple annunciation. It's not perfect, but it might provide peace of mind, especially if you operate older equipment and are paranoid about communications failure.

PASSIVE DETECTION

EES says there is nothing inside the 3.1 by 4.75-inch Trans-Ind housing that will interfere with any of the aircraft systems, including the comm

radios and GPS receivers. Instead, the passive system simply listens for radio frequency energy that's emitted from the onboard antennas (the system detects the 118 to 137 MHz frequency band). The indicator won't respond to smartphones or other portable electronics (unless it's a portable comm transceiver). The unit will register transmissions from a 121.5 MHz ELT system.

The Trans-Ind operates on a single 9-volt battery that can last upward of 100 hours. EES suggests mounting the unit on top of the aircraft glareshield, but you can also operate the unit from the palm of your hand. The company cautions that small aircraft vary widely in the amount of radio energy that filters into the cockpit, so before mounting the unit you'll want to test for dead spots that might not trigger the transmit indicator, and mount

the unit as high as possible.

We found the Trans-Ind simple to use. There's a single power button on the front of the case, in addition to two sunlight-readable LEDs.

When the unit powers up, both the blue and yellow LEDs blink during the self-test. When the power is on, the blue LED dimly illuminates while the unit listens for RF energy.

Keying a transmitter will illuminate the yellow LED, much like the TX indicator that's on many comm radios. The real advantage of the Trans-Ind, however, is the modulation indicator. As you talk through the microphone, the blue LED comes on, confirming that your radio has both transmit key and voice output. The Trans-Ind is also used to indicate a stuck microphone, made obvious by an activated yellow LED.

Now the warts. The unit could indicate transmissions from other aircraft on the ground and it can also be activated by fixed transmitters, such as ATIS or other continuous sources of transmissions.

Still, we think the Trans-Ind could be useful for preflight testing and for initial diagnostics before surrendering the aircraft to an avionics shop. Visit www.eesys.co, 503-490-5852.



Ercoupe/Aircoupe/Cadet

Too often overlooked, the line has abilities that will surprise the uninitiated.



Everyone knows the Ercoupe was designed to be super safe by making it stall and spin-proof, yet few know it racked up a number of firsts including first successful production GA airplane that had a nosewheel or that had a fully cowled engine—making it faster than most of its contemporaries. Even fewer are aware that its design means it can handle a crosswind of double the velocity that can be dealt with by almost any other airplane.

However, the Ercoupe/Aircoupe line doesn't come across as macho, so what may be the funkiest two-place airplane from the 1940s is a bit of a sleeper on the used market. We think the series is overlooked by potential buyers who don't understand its capabilities.

These days, the venerable 'coupe remains one of the cheapest ways to get into the air. A nicely kept up early Ercoupe retails for \$16,000, although a pristine restored model may sell for much more. Some can be had for as low as \$10,000, but prospective buyers should watch out for basket cases in that price range.

Surprisingly, 20-year newer (1968-1970) Mooney Cadets—Ercoupes

with a single tail and rudder pedals—are also selling for about \$16,000.

The C model, the only model that has a low enough gross weight to qualify for Light Sport, is quietly becoming an in-demand airplane. Its \$14,000 value in the *Aircraft Bluebook* may be behind the times.

If you find a decent example of the

We think the Ercoupe series is overlooked because pilots don't understand its capabilities.

series, you get a fun airplane suitable for Saturday afternoon joyrides on nice days or modest cross-country trips. You can fly along with the canopy open, your elbow out in the breeze and handily overtake the folks in the two-place Pipers and Aeroncas that cost more and have the engine cylinders dragging along in the wind.

MODEL HISTORY

First of all, is it Aircoupe or Ercoupe or Cadet? It depends on who you talk

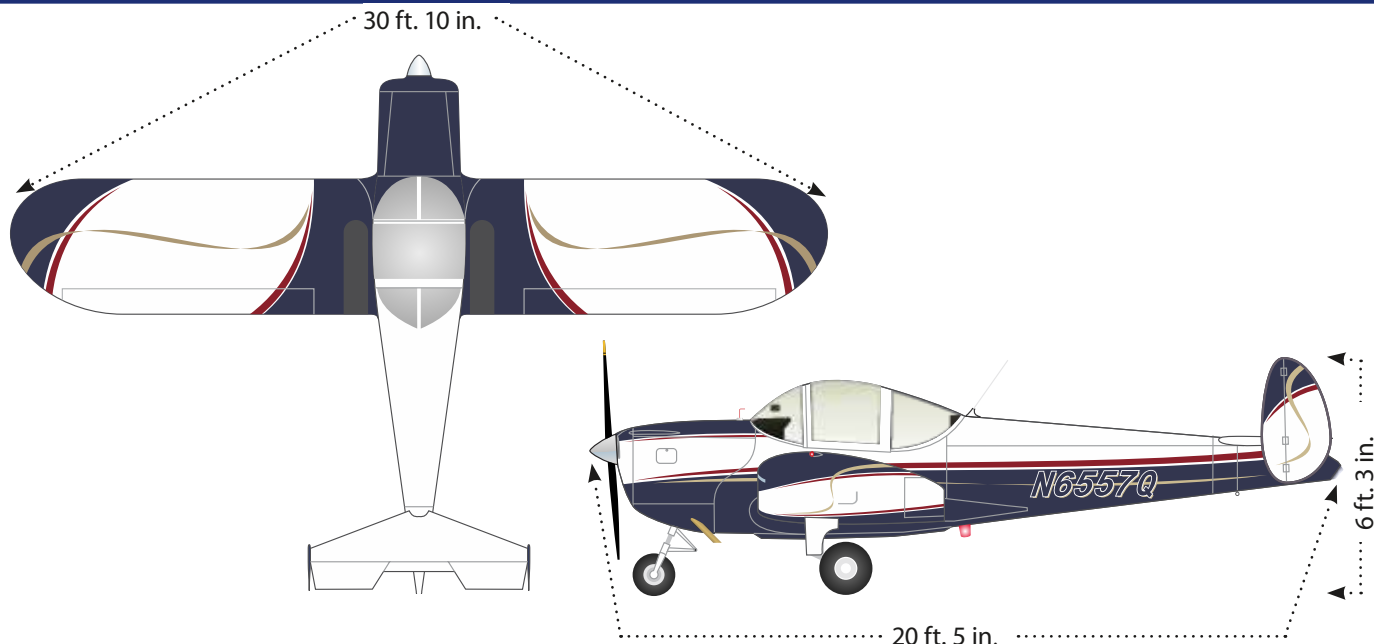
to and also the year of manufacture. The airplane has a long, complex history with on-again, off-again production dating back to prior to World War II and then the brief, but intense, post-war boom.

The first model appeared in 1939, and was manufactured by the Engineering Research Corp. (ERCO), which was the source of the "ER" in Ercoupe. It was designed by Fred Weick, very much an aeronautical genius, who went on to design the first truly crashworthy ag-plane, which became the Piper Pawnee, and to collaborate on the design of the Piper Cherokee line. As a National Advisory Committee for Aeronautics (predecessor of NASA) engineer, Weick had designed the Weick W-1 in response to a call for an airplane that could not be stalled.

Back then, the W-1's design was a very big deal because stalls were even worse killers than they are today. They weren't well understood, and the small engines available for GA meant shaky performance and a relatively small envelope between cruise and stall speeds.

Weick went to work for ERCO and used many of the techniques he'd

ERCOUPE/AIRCOUPE/CADET

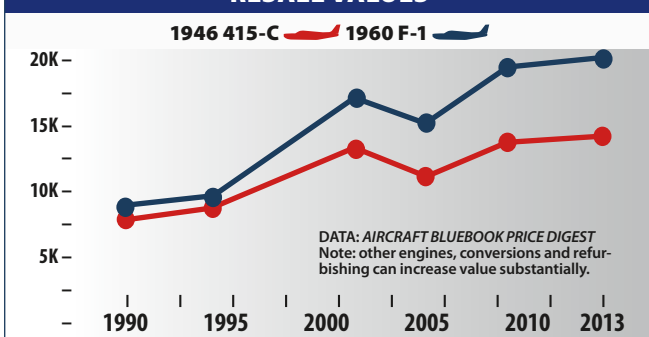


drawings courtesy
www.schemedesigners.com

ERCOUPE/AIRCOUPE/CADET SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1946 415-C	75-HP CONTINENTAL C-75-12	1800	\$20,000	24 GAL	440 LBS	90 KTS	±\$14,000
1949 415-G	85-HP CONTINENTAL C-85-12	1800	\$20,000	24 GAL	480 LBS	100 KTS	±\$17,000
1960 F-1	90-HP CONTINENTAL C-90-12F	1800	\$20,000	24 GAL	480 LBS	100 KTS	±\$20,000
1969 M 10	90-HP CONTINENTAL C-90-16F	1800	\$20,000	24 GAL	460 LBS	100 KTS	±\$15,750

RESALE VALUES

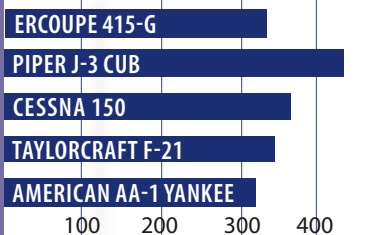


SELECT RECENT ADS

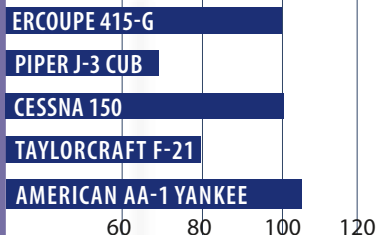
AD 2012-08-06	INSPECT AILERON AND AILERON BALANCE ASSEMBLY FOR CRACKS
AD 2003-21-01	INSPECT WING OUTER PANEL FOR CORROSION
AD 2002-26-02	INSPECT WING CENTER SECTION FOR CORROSION
AD 2002-16-04	INSPECT/REPLACE FUEL LINE NIPPLE FITTING
AD 59-05-04	REAR SPAR INSPECTION/REINFORCEMENT

SELECT MODEL COMPARISONS

PAYLOAD/FULL FUEL, POUNDS



CRUISE SPEEDS, KNOTS



PRICE COMPARISONS

'49 ERCOUPE 415-G	(\$14,000)
'46 PIPER J-3 CUB	(\$20,750)
'75 CESSNA 150	(\$17,000)
'80 TAYLORCRAFT F-21	(\$22,000)
'71 AMERICAN YANKEE	(\$19,000)



developed with the high-wing W-1, including limiting up-elevator travel for stall resistance, for the low-wing Ercoupe.

Production continued on the original Ercoupe through 1941, when the attack on Pearl Harbor brought all U.S. civil aircraft manufacturing to a standstill. Some 112 were built before the war.

Post war, ERCO got in high gear and pumped out more than 4000 75-HP Coupes in 1946, an impressive volume second only to Mr. Piper's Cub. These models are known as the 415-C and they have a four-cylinder Continental C-75-12. (Many have been converted to C-85-12 engines.)

The Model C and CD, with a 1260-pound gross weight, are the only Ercoupes that qualify for Light Sport.

Production of the 415-C, D, E and G models continued until 1950. Model changes in the C and D were minimal, but the D model got a weight increase to 1400 pounds by

further limiting up-elevator travel. The C and D had 75-HP engines while the E and G had 85-HP powerplants. The E and G models also had split elevators.

The post-war boom evaporated by 1947, hitting the two-place market hard. ERCO soldiered on until 1950, eventually building about 5000 airplanes. It then sold the Ercoupe type certificates to Univair. Univair didn't build any complete airplanes, but did support the line with new parts.

In 1958, a company called Forney took over production rights and introduced a spruced-up model called the Fornair F-1 Aircoupe. The F-1 'coupe had a 90-HP Continental C-90-12F but otherwise retained most of the design features that ER had developed. Forney built a couple of hundred airframes before retiring production.

Rights to the airplane were eventually purchased by Alon, Inc., which built 245 airplanes between 1962 and 1967. Alons have a bubble canopy rather than the sliding windows

How it all started—the Weick W-1 mounted inside a wind tunnel for testing (above left). How it all ended—Mooney M-10 Cadet, the final iteration of the Ercoupe series (below left).

found in the earlier models.

Surprisingly, the line was then sold to Mooney—yes, Mooney—which made major modifications to the airframe, including a single tail in place of the original's Lockheed-like twin-fin design and retained the rudder pedals, which Alon had added when it took over the design. (You can add pedals to any Ercoupe via a kit sold through Univair—www.univair.com—for about \$1400.)

Mooney had in mind a basic trainer and called the revised model the Cadet. But it wasn't much of a seller. Only 118 airplanes were made between 1967 and 1970.

By 1973, rights were sold back to Univair, the same company that had bought the design from ERCO. As before—and still—Univair supported the airplane with new parts production. All told, nearly 5800 Coupes were built, with the last one coming out of the Mooney plant in 1970. For all practical purposes, however, the majority of Ercoupes were built between 1945 and 1952.

DESIGN HIGH POINTS

At a time when most civil aircraft were covered in fabric stretched over welded tubular frames, the 'coupe was an all-metal, riveted design but with fabric-covered wings on early models, later changed to all metal.

The Ercoupe had a pair of vertical fins on a single tail boom, a design that had become popular with Lockheed and Beech twins in the 1930s. And although the Ercoupe had rudders, it had no rudder pedals. The cockpit floor has but one pedal, for the brakes, helping with legroom for tall pilots. The twin tails put the rudders outside the twisting propwash, designing out some, but not all, of the left-turning tendency in a climb. The airplane still needs right wheel during a climb.

Weick set out to confront two safety issues of the day: stall/spins and groundloops. That meant the

Virtually all of the airplanes in the Ercoupe series have had panel mods of some sort (lower right). An original panel is rare (right). The absence of rudder pedals improves legroom.

Ercoupe was one of the first civil aircraft to take advantage of what was being learned about the stability of a nosewheel versus a tailwheel for control on takeoff and landing. It took the rest of the industry another decade to adopt this visionary idea.

Further, the Ercoupe had a collar on the control column that limited elevator up travel—if you can't reach the critical angle of attack, you can't stall the airplane. And if you can't cross control—remember, no rudder pedals—you can't spin it, either. The airplane has rudder control, but it is automatically coordinated with the ailerons through a mechanical linkage (only the rudder on the inside of a turn deflects).

The no-stall, no-spin philosophy drove the design entirely. The restricted elevator travel required a nearly constant CG so the Ercoupe had side-by-side seating. The lack of rudder controls presented a theoretical problem on crosswind landings, so Weick's solution was a rugged trailing-beam gear design that allowed the airplane to be plunked down in crosswinds, without the usual side-slip correction.

Owners say the gear is more than beefy enough to stand the load of landing in a crab, and control authority is sufficient to keep the airplane tracking correctly once it's on the pavement. You can do a bad landing in an Ercoupe, but it takes effort to damage the gear.

It's not, as some think, a castering crosswind gear as in some versions of the Cessna 190/195. After a crabbed touchdown, the airplane immediately turns to point in the direction it is traveling, so you feel the sideload on touchdown. You then steer the airplane with the control wheel during rollout, turning slightly away from the wind to counteract the tendency of the airplane to weathervane.

Rudder purists sneered, but the Ercoupe was successfully tested in crosswinds up to 40 MPH—far



beyond the capability of almost any aircraft, then or now. True, it took nerve to drive the thing on in a stiff crosswind, but the gear proved up to the task. With the landing gear properly adjusted and the top of the tails 75 inches above the ground, the wing sits at a zero-degree angle of attack when the airplane is on the ground. This allows landings to be performed at speeds up to an incredible 110 MPH, although owners we spoke with were not willing to try such a speed.

Indeed, when Boeing came along with its Dash 80, the 707/717/KC-135 prototype, it used the lowly Ercoupe to train pilots to land the new airplane. Because of its low-slung engine pods, the new jetliner couldn't be slipped to a landing. Pilots had to learn to land it in a crab and ride out the rubber-induced correction.

And, in fact, the initial design was good enough not to require much meaningful fiddling. Rudder pedals were made available as an option in 1949, mostly as a psychological crutch to entice pilots who thought a "real" airplane had to have two pedals on the floor.

In most Ercoupe models, fuel capacity is 24 gallons, in two nine-gallon wing tanks and a six-gallon header tank between the panel and the engine. An engine-driven pump sends fuel from the wing tanks to the header tank, from where it gravity feeds to the carburetor.

There is a float with a wire sticking out of the header tank. Once it starts down, either because all of the fuel in the wing tanks is depleted or the



engine-driven fuel pump has failed, you have about an hour before it gets quiet up front. As with some Cessnas, there's no fuel tank selection, just a simple on/off switch located on the cockpit sidewall.

From a crashworthiness standpoint, the fuel system design is grim. The wing fuel tanks are in front of the spar, unprotected on impact. The header tank, as with too many of the Ercoupe's contemporaries, is between the occupants and the engine. We were convinced that we would see several accident reports of post-crash fires. Surprisingly, to us, in looking back through 40 years of NTSB reports on the series, we found only two. One was a crash into trees after a go around and one was a loss of control and high-speed dive into the ground event.

The airplane developed somewhat of a "not a real" image for its lack of rudder pedals. The blasted thing was too easy to fly, suggesting that anyone who would own one didn't have the right stuff at a time when the phrase hadn't even been coined yet. This is an absurd state of affairs, of course, and one that seems to dog every radical safety idea, from seat belts up to and including ballistic parachutes.

WRECKS—POWERPLANTS PREDOMINATE

Given that there were something over 5700 Ercoupes/Aircoupes/Cadets built, we were surprised when we looked back through 40 years of accident reports and found only 45 that involved the little tricycle-gear two-seater. Of those, only seven involved fatalities, and although the Ercoupe line has a reputation for post-crash fires because of the location of the fuel tanks, we found only two—and they were fatal.

We do not have data regarding the number of hours 'coupes are flying, nor how many are airworthy. Nevertheless, we were struck at the low total number of accidents and the fact that only about 13 percent were fatal. Without more information, one can't make pronouncements—nevertheless, maybe, just maybe, Fred Weick succeeded in his goal of building a safe airplane.

What we did see was a combination of accidents due to poorly maintained airplanes—the bane of aging airframes—and pilots clinging to traditional sorts of stupidity when confronted with an airplane.

Of the 39 accidents, 13 involved engine power loss for a mechanical reason. Most involved fuel system components that failed because they were worn out and should have been replaced or were installed improperly during recent maintenance, often by the owner himself who didn't hold an A & P rating.

In one accident, the pilot knew there was a problem with the mixture control, but kept flying the airplane. On the day of the accident, he noticed that the engine wasn't making power during climbout, but decided to continue with his cross-country flight. Thirty minutes later the condition progressed to the point of engine stoppage.

Only two accidents involved fuel starvation. Should the engine-driven fuel pump fail, the six-gallon header tank will continue to supply the engine, but it means finding a place to land within an hour. It does

not mean doing as one optimist insisted on doing—making touch and goes at different airports as the fuel quantity float continued its inexorable decent toward “that's all, folks.” He tore up his Ercoupe landing in a field.

Eight accidents involved crashing while trying to land, before getting to the runway. In a couple, the pilots got the wheel all the way aft, hitting minimum speed and set up a high descent rate that they did not arrest.

Eight accidents were runway loss of control accidents, a low number compared to all other airplanes. Of those, only two were the classic hit, bounce, swerve and run off the runway. Of the other four, three involved breaking off the nosewheel and one was a downwind landing on an icy runway—he kept it on the runway, but couldn't get stopped without the help of a big pile of snow.

The flat climb gradient bit five pilots, some of whom may have exacerbated things by being over gross—they hit something after getting the airplane into the air.

VFR into IMC accidents proved to be 100 percent fatal for the two pilots who didn't succeed.

There were two in-flight break-ups. In one, the passenger pulled the yoke full aft shortly after the engine quit due to fuel exhaustion. He yanked the wings off of the airplane.

Ercoupe series accident reports seem to reflect that the airplanes are safe overall. In addition, we feel the landing gear and steering design does help prevent RLOC. The data clearly show that the health of the powerplant and its systems has to be carefully monitored and maintenance not deferred. Further, the modest power up front and the ability of the airplane to get into a high sink rate condition has to be respected when approaching to land as well as clearing obstructions after takeoff.

After a series of minor engineering changes, the Forney airplanes got all-metal wings. To this day, there are debates as to whether this was an improvement. Alon added a sliding canopy, replacing the earlier slide-up/down windows.

Reverting to high-testosterone thinking, Mooney, calling it the M-10 Cadet, revamped the Ercoupe's image by installing a single tail—complete with the trademark “backward” vertical leading edge and angled trailing edge. The Cadet also had standard rudder pedals, with enough elevator authority to actually stall briskly and even stall strips, so the airplane would stall like a “real airplane.”

PERFORMANCE

With its twin tails and somewhat sleek design, the Ercoupe looks fast to some eyes, and it ain't bad. Despite having a fat, low-aspect ratio wing that's excellent for slow speed and stall characteristics but middling for climb and cruise, a 90-HP Ercoupe will run with a Cessna 150 or Luscombe.

A 75-HP 'coupe will struggle climbing above 4000 feet on a warm day with two people aboard; solo, it's not bad. One owner said his 85-HP model with a climb prop “loves the ground.” He noted that if you put two people and some baggage aboard, you know you're really carrying a major load. “They claim 500 FPM for the first five minutes, but mine never does that well.”

An Ercoupe is not a short-field machine—it also uses much more runway departing than it does landing. The twin tail design did not eliminate all left-turning tendency—P-factor is still there—so allowing the speed to get much below 75 MPH in a climb means there will be so much drag from aileron and rudder deflection that the rate of climb can be frighteningly low when trying to clear an obstacle.

Like other airplanes of the day, such as the J-3 Cub and Champion, the Ercoupe is not an all-purpose machine, performance wise. The 75-HP models will be zippy enough for solo flying but if you want to do much two-person flying, try to find a 90-HP Alon model or, at the very least, an 85-HP version with a climb prop.

Then again, among the post-war

designs, Ercoupes hold their own, and then some. Plan on around 100 MPH in 75- and 85-HP models and perhaps 110 MPH in the 90-HP models. By comparison, you'd be lucky to see 80 MPH in an early Cub, and even late-model Cessna 150s struggle to make 110 MPH.

A 'coupe really will handle very strong crosswinds. Owners reported landing in direct crosswinds of more than 30 MPH. Jack Arthur, executive director of the Ercoupe Owners Club, confirmed the ability of the airplanes to land in very strong crosswinds, but noted that one place where Ercoupe pilots do get into trouble is attempting to take off in very strong crosswinds.

FLYING QUALITIES

So what's it like to fly an airplane with no rudder pedals, a canopy/windows you can open in flight and systems straight out of the 1940s? Different, to say the least. Then again, that's what attracts owners to the Ercoupe in the first place. It's never going to be accused of being your average spam can.

Generally, the 'coupe is a good flyer with appealing handling characteristics. It has full-span ailerons—no flaps—so roll response is far snappier than other airplanes of the same era. Properly rigged, it will not stall—the up-elevator restriction means the airplane has a "minimum speed" in 1 G flight. It won't go any slower—power off, it simply descends under full control.

The downside is that the sink rate can become eye-watering. Our accident survey found that at least five 'coupe accidents on landing were due to the pilot failing to arrest a high sink rate after getting slow. This was consistent with Jack Arthur's comments to us that besides trying to take off in a stiff crosswind, the second area where Ercoupe pilots get into trouble is with allowing a high sink rate to develop.

Also, in a steep turn, you may reach full aft wheel and full power but be unable to maintain altitude—potentially developing a stunning rate of descent. The only way to stop the sink is to roll out of the turn. It may be necessary to fly level to accelerate to a speed at which the airplane will begin to climb.

The rapid rate of descent allows

for precise and impressive short-field landings but if you're not careful, the same trait can and will put you in the weeds short of the approach end of the runway.

Once a 'coupe has been slowed to its minimum speed on final, it will not flare without adding a lot of power because the yoke is already fully aft.

In reality, an Ercoupe is quite easy to land. The trailing beam gear is forgiving, usually soaking up the too-high arrival rate of a ham-fisted pilot. In a bouncy crosswind, just crab the airplane into the wind and touch down as you would with no crosswind. The airplane will reliably right itself on the runway and the rest is easy, although you do have to steer away from the crosswind—counterintuitive for aileron positioning for pilots who fly three-control airplanes.

Luddites who insist on having rudder pedals can find a model so equipped, but one owner of a pedal-equipped Ercoupe says he crabs it onto the runway anyway. Another owner who contacted us thinks the rudder pedal mod is actually dangerous because it's not connected to the nosewheel and may confuse pilots about ground handling. On the ground, you drive the Ercoupe like a car, steering with the control yoke, not the pedals.

MAINTENANCE, PARTS

A top concern for anyone buying a nearly 70-year-old airplane is parts availability. Fortunately, any model that was built in the thousands—as the Ercoupe was—is usually still around in sufficient quantity to represent a profitable market for parts makers.

For Ercoupe owners, the best source of parts continues to be Univair (www.univair.com), which holds the type certificate for the airplane and makes most structural parts.

Another company, Skyport Services (www.ercoupeparts.com), specializes in Ercoupe parts, STCs and accessories and is a cornucopia of 'coupe-iana, including an STC for gross weight increase on some models.

Owners highly recommended the Ercoupe Owners Club (www.ercoupe.org), said it is passionate about the care and feeding of the marque



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and has a good website and newsletter for all thing 'coupe.

As with any older aircraft, the largest area of concern with an Ercoupe is corrosion. There have been two ADs calling for inspection for corrosion in the wings, AD2002-26-02 and AD2003-21-01. Buy the wrong airframe and you could face potentially uneconomic repair costs. Since many Ercoupes have and continue to live outdoors, water incursion is a worry.

Water tends to leak into the fuselage and corrode the belly skins. The tail cone and wing spar lower caps are also corrosion-prone areas. Mice can also be destructive. It should go without saying that on a pre-buy, the inspecting mechanic should check the airplane carefully for corrosion. The Ercoupe Owners Club website has a good pre-purchase examination checklist.

Another common problem in the Ercoupe is the nosewheel, especially the single-fork models on the earlier airplanes. Decades of landings and abuse and side loading due to crabbed landings in crosswinds will take a toll. Shimmy can be a problem due to loose or worn nosewheel linkages.

Look for the double-fork nosewheel and check the linkage. Some Ercoupes have been converted from the single fork design. If that hasn't

been done, it may be worth considering, although some owners say the single fork is fine.

Main gear struts can also be a problem, again due to years of pounding. The shock struts can seize up if they're too low on fluid, and landing forces are transmitted directly to the wing spar center section. Check it for damage and look for a reinforcement gusset that has been retrofitted to many airplanes.

Check for unrepaired damage. One accident was triggered by wing-tip damage that had simply been Bondoed over. As older airplanes go, the Ercoupe isn't overburdened with a huge number of ADs but one to check for is AD 59-05-04, which calls for beefing up the rear spar where the outer wing panel attaches. Noncompliance with this AD can be a killer.

There are a number of mods for the series; the 100-HP Continental O-200 engine upgrade is popular.

SUMMING UP

Owners tell us the Ercoupe is what it is: a fun, easy-to-fly airplane with few bad habits that's a good choice for a starter airplane.

On the other hand, a prospective buyer shouldn't go into the deal looking for a steal.

Of all the Ercoupe models to choose from, we think the later Alon

Access to the engine room is easy, courtesy of cowling halves that open fully, although at first glance it's disconcerting that the engine seems to only have two cylinders. It really has four.

and Forney models may be the better values, even if they cost a little more.

The early airplanes had fabric wings—a plus for inspections—but the later models with metal wings have been equipped with inspection panels, so hidden corrosion is less of a worry. It can be found, if you look.

Last, don't expect too much of an Ercoupe. If you have places to be and things to do and serious cross-country is on your list of desires, the Ercoupe is not a good choice. But it's an eminently affordable and maintainable weekend fun flyer with a certain 1940s classic panache.

OWNER COMMENTS

I purchased my 1946 415-C about four years ago. It had been sitting outside, unused for about five years. Although its engine was in excellent shape, numerous repairs were needed, including recovering the wings. I purchased the plane for \$10,000 and spent about \$20,000 for an A & P to refurbish the airplane and recover and paint the wings. I have flown it about 100 hours for each of the past three years.

It's a unique airplane and often receives compliments from controllers, line personnel and other pilots. It's always fun to answer the question, "How does it fly without rudder pedals?" with, "What's a rudder pedal?"

I think \$30,000 is about right for a price for a good, airworthy Ercoupe that's Light Sport qualified. I spend about \$7000 per year, including hangar and insurance, and maintain the airplane in good condition. Of that, maintenance has run about \$1700 annually and fuel \$3000.

It excels in every way. There's plenty of room for someone six feet three inches tall, the heater is great and it has 30-MPH crosswind capability. It will fly in weather that will leave others on the ground waiting for warmer days or calmer winds. I figure on a cruise at 100 MPH, although if I want to pull back to a



In full and fearless flight—it's a sunny day and the windows are open. Life is good.

fuel burn of 4 GPH, it cruises at 80 MPH.

The only mod I have on my Ercoupe is a cigarette lighter socket that receives a solar trickle charger when parked.

There is great support for Ercoupes—two parts vendors, Univair and Skyport, and an owners group that has more than 700 members and holds daily online discussions about every topic relevant to Ercoupes.

Fred Goff
Via email

My Ercoupe interest began with a 1943 *Popular Mechanics* article. Eventually, one came up for sale at my local field—I sold my share in a Cherokee and became an Ercoupe owner. I don't understand how some people can sneer at 'coupes because they are, to me, really flying. The Cherokee was somehow all closed in and insulated, like an old station wagon. Much of the year I fly the Ercoupe with the top down; it's wonderful.

Even repowered with a C-85 (which is an improvement over the C-75), it burns below 4 GPH a lot of the time. As for speed, it will exceed 114 MPH. Plus, people like to come up and talk about the airplane.

It's an honest and straightforward airplane to fly—a reasonable crosswind is no problem at all. It is a trifle chilly in January. I have no plans to "move up"—I'm there.

Parts and repair? Skyport has good, helpful people. Best may be the Ercoupe Owners Club. It has on-

line offerings about what to look for and questions to ask. When learning the ins and outs of my airplane, online conversations with members eased the way and brought me into the community.

Fred Weick's work of all those years ago certainly bore some wonderful fruit. For me, the Ercoupe is the most fun flying I've had.

Steve McNew
Via email

Once the pilot understands the peculiarities of the plane, about the only thing he or she can't do in it are slip and spin. I've landed my Ercoupe in a 28-knot direct crosswind with no problem. At a fly in, I watched four Ercoupes and a Grumman Tiger land in a gusty crosswind—only the Tiger had to go around.

Obviously, both takeoffs and landings in a crosswind are handled differently from a three-control airplane. Also, on the ground, the wing has no angle of attack and will not fly at any speed until the nose is raised. This allows the airplane to gain flying speed with the nosewheel safely on the ground. Then the airplane can be popped into the air and a turn made into the wind to set up the appropriate crab for climbout.

Crosswind landings are made crabbed; the trailing link gear will swing the nose forward as soon as the main gear are on the ground.

There are a number of mods for the Ercoupe; four that come to mind are: enlarged baggage compartment, alternator conversion, master relay at the battery (providing more safety for the electrical system) and Cleveland wheels and brakes.

Larry Snyder
Via email

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PILATUS PC-12 NG

(continued from page 7)

that the path of the airplane is depicted rather than its attitude.

If the symbolic airplane is on the horizon, the airplane is flying level, no matter what its speed. It takes only a short time to adjust to after years of flying pitch attitude displays, and then one wonders why this isn't standard on all glass cockpits.

In a steep turn—the PC-12 NG is nicely responsive in all axes—simply putting the track display on the horizon means holding altitude. When lined up with the runway using the synthetic vision presentation, the system will build a three-degree glideslope—and placing the track display 1000 feet past the runway threshold means that's where the airplane is going and where you're going to start your flare.

MANEUVERING

Maneuvering the PC-12 NG in steep turns, slow flight and in a very tight traffic pattern showed another reason why this airplane is popular with a wide variety of users. It's nimble and responsive—forces are similar to a Beech Baron or 400-series Cessna.

Due to rolloff at the stall with power—good grief, it's got 1200 SHP up front—stalls are prohibited and the airplane has a stick shaker and pusher. We found control to be smooth and positive in all axes well into the regime of the shaker, with no problem making abrupt rolls at very slow speed. The pusher

doesn't mess around, reducing angle of attack assertively.

Full flaps, 40 degrees, provides substantial drag so flying out of a stick pusher event, with full power applied smartly, still requires the sacrifice of a few hundred feet to accelerate out of the near stall speed regime and establish a climb.

ANGLE OF ATTACK

Another feature we applaud in the NG airplanes is the integration of the angle of attack system into the airspeed presentation. Rather than a separate AOA indicator, information from the twin AOA sensors (one on each wing) is fed through Apex to a green Dynamic Speed Bug on the PFD.

The presentation damps AOA indications that bounce around in turbulence and shows a true 1.3 V_{so} speed to fly on final. The system corrects for icing conditions—once ice protection is activated, the AOA presents the appropriate speed to fly with an ice-contaminated airframe. It's miles ahead of the current technique of "keep the flaps up, go as fast as you can on final to avoid stalling and hope you can stop before you run out of runway."

Landings are embarrassingly easy with the trailing beam gear and effective rudder. The PC-12 NG has a range of demonstrated crosswind numbers, based on flap deflection—the highest being 30 knots. The only GA airplane we know that can handle stronger crosswinds is the Ercoupe.

Control on rollout is positive—getting down and stopped on a 3000-foot runway at sea level should not present any problem

FEEDBACK WANTED

AA-1 SERIES



For the February 2014 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the American General AA-1 series, two-place, low-wing airplanes that began with the American Yankee. If you've flown or owned one, we want to know about your experience: how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your airplane to appear in the magazine, send us any photographs you'd care to share. We accept digital photos e-mailed to the address below. We welcome information on mods, support organizations or any other pertinent comments. Please send correspondence on the American General AA-1 series by December 1, 2013, to:

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to a pilot who flies final on speed, although our review of accidents indicates that the leading cause of PC-12 landing accidents is too much speed on final.

CONCLUSION

We think that Pilatus has taken one of the best all-around airplanes on the market and made it several notches better. The combination of upgrading to the user-friendly and capable Honeywell Apex system, bumping up the power of an already big engine with minimal range loss, and integrating the AOA into the Dynamic Speed Bug serve to enhance safety and increase the utility of an airplane that does almost everything well.