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The consumer resource for pilots and aircraft owners

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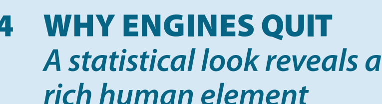

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SHOULD YOU BUY A USED HOMEBUILT?

Whether it's traveling or kicking around home base I get asked that a lot lately. And it's often from longtime airplane owners tired of shelling out retirement bucks to feed an old Bonanza or Cessna 180, especially for avionics upgrades, plus buyers are still recovering from the ADS-B buy-in. Non-TSO (but STC'd) gear has lowered prices for EFIS and autopilots, but not as low as experimental stuff, which require neither certification standard. Compare a glass upgrade from the round gauges in a Lancair IV to the same upgrade in a Mooney and I think E/A-B, or Experimental Amateur-Built aircraft—call them homebuilts, kits or both—look pretty compelling.

But the buzzkill comes halfway through the project when you realize—without an airplane—you really want to fly your kit, but don't have the time to finish it. Maybe buying one that someone finished is the better option. But do you really want to buy an airplane that someone else built? In plenty of cases the answer is yes, and in plenty others it's hell no. I've had my hands in both and have been both impressed and frightened by what I saw. When asked to be pointed in the right direction, I usually recommend joining up with a local EAA (Experimental Aircraft Association) chapter. Here you're bound to find someone who can help with the sharp-eyed process of finding a quality build. But you gotta know what you want, first, and many buyers simply end up with the wrong airplane. I've seen some of them auger. That Lancair IV won't play in the ice like your Bonanza did. But man, does speed rule in the world of homebuilts.

I suggested to one local who just earned an instrument rating and was tempted by an early Cirrus SR20 to also look at the Van's RV-10. This is a close enough matchup when it comes to four-place performance, but the RV-10 beats the SR20 by an easy 16 knots, has a slight edge in useful load and flies off with less runway. Prices for both models are all over the board, from $140,000 to $275,000 for an RV-10, while an SR20 can start at $125,000 and top $400,000.

Maintaining an experimental is a little different, even though—like a certified airplane—every year someone has to sign it off as being airworthy. To do that, the original builder generally gets a repairman certificate from the FAA after completing the final build signoff. This gives the builder an authority to do a yearly condition inspection on that airplane. But if the airplane changes hands, the new owner will likely be taking the airplane to a licensed A&P for the inspection. Depending on the model, that might be easy or impossible.

Marc Cook, my counterpart over at sister publication *Kitplanes Magazine*, reminded me that buyers crossing the line between used certified airplanes and experimentals need to go into the buying process with eyes wide open, and with a healthy level of self-learned expertise. That includes being able to recognize a good, bad and mediocre build quality. That also applies to the quality of the avionics install, and there could be a lot of critical integration, especially autopilot interfaces. In my experience, a hacked avionics install often reflects the rest of the aircraft's build quality.

Kit aircraft are typically the cheaper buy-in, with the bonus of sometimes getting a newer and more modern airframe, including composite design. Many homebuilts are already nicely equipped with modern gear, although expect a mix of old and new—and be ready to debug once it's your airplane. What many fail to realize is that most of the more common experimentals have certified or certified-like engines and propellers. And the best part is an owner can modify the airplane (and build parts for it) any way they wish without having to deal with STCs, FAA field approvals and money-burning TSOs.

On the downside, compared to a certified model there will be a lot of varia-

continued on page 32

WHICH ADS-B TRANSPONDER?

The article in the February 2020 issue of *Aviation Consumer* on budget transponders was interesting, and I'm wondering if I can get some advice for an upgrade.

I operate a Cessna 140 strictly VFR and have to replace my old King transponder. The airplane has no ADS-B equipment, however, and I would like to change that.

Your articles have suggested that my best solution would be an all-in-one ADS-B transponder. Can you suggest a budget ADS-B transponder for my situation ?

Marinus Hamer
via email

If you need a transponder and mandate-compliant ADS-B Out our advice remains the same, and that's consider an all-in-one transponder. There are three choices that first come to mind, since we assume your Cessna 140 doesn't have a mandate-compliant WAAS GPS position source.

As we reported in the March issue of the magazine, uAvionix now has a new solution with its tailBeaconX tail light transponder/ADS-B system, pictured here. It's not fully certified yet, but it probably will soon.

For a traditional rack-mounted transponder with a lower budget in mind, consider the Appareo Stratus ESG or the Garmin GTX 335. They have integral WAAS GPS and comply with the mandate. If it were our airplane, we would get quotes for all and compare the bottom line.

DITCH THE BATTERY BOX

Regarding your battery box replacement article (February 2020 *Aviation Consumer*), I did something a bit different and converted my Marchetti SF-260 from a Gill battery with vents to a sealed Concorde battery.

This was ultimately signed off with an FAA Form 337 and it was quite easy. Why wouldn't everyone do the same and get rid of their battery boxes completely?

Peter Vilkin
via email

We've heard of others doing the same, but we've also heard that some shops won't remove the battery box without getting a an FAA field approval, which was too costly.

HOW MUCH FUEL IN A CARDINAL RG?

In my owner comments on operating a Cessna 177RG, I talked about the extended range fuel tank. To be clear, this is a 160-gallon tank that does not have an STC, but instead is installed via an FAA Form 337.

What I didn't state is that this is, per the 337, for the "temporary installation intended for a one-time repositioning flight," and is basically a ferry tank that is easily installed and removed by authorized persons.

Sherif Sirageldin
via email

Part of that was our bad: We botched the edit and called it a 60-gallon tank, which would seem more fitting for an STC. It is neither.

PROPELLER OVERHAULS

The propeller overhaul article in the March 2020 issue of *Aviation Consumer* was the most detailed, in-depth coverage I've ever seen on the topic, and the reason I have been a subscriber for many years.

I've owned a total of six airplanes over time and all had either two- or three-blade metal props and all have been overhauled just as your shop tour described. Now I own an LSA with a little composite prop. I'm not anywhere near the TBO, but is this propeller as easy to rebuild or repair as a metal prop?

George Kawalski
via email

Not from what we saw during our shop tour. Working with composite blades is time-consuming and many of the repair procedures are different than with metal ones. We'll follow up with an article that focuses on composite props.

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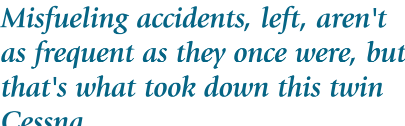
On The Cover: **That's a hangar full of Cirrus models at the factory service center. As you'll learn in the used composite airplane article that begins on page 8 of this issue, there are plenty of good used models to choose from on the current market, including Diamond, Cirrus and Columbia/Cessna, but doing the right prebuy evaluation is imperative.**


Misfueling accidents, left, aren't as frequent as they once were, but that's what took down this twin Cessna.

FLIGHT SAFETY

Why Engines Quit: Failures Are Avoidable

Up to half of engine failures are pilot or mechanic induced. Large displacement engines have a slightly higher failure rate.

by Paul Bertorelli

Engine failures are the stuff of nightmares. Maybe not quite so agita-inducing as your mechanic calling with a compression report, but worrisome nonetheless, even if aircraft engines are designed with reliability in mind.

So are they reliable? Well, yes, if you let them be by slaking them with gas and oil, following the procedures written right down there in the POH and avoiding the maintenance blunders that cause a surprising number of engines to fail in flight.

Mechanical failure persistently accounts for about 15 percent of all crashes in general aviation, but not all mechanicals are engine related. Let's put the standard risk metric on it. In 2016—the most recent year for which we have complete data—engine-related accidents amounted to 0.21 accidents per 100,000 flight hours, which is about 25 times lower than the overall accident rate. And considering that up to half of all engine failures are avoidable human-induced calamities, the risk could be even lower than that. But to avoid doing the stupid stuff, you have to *know* what the stupid stuff is and that's what we're covering here.

Failure to properly torque cylinder through bolts spun a main bearing and caused failure in the O-360 connecting rod, left.

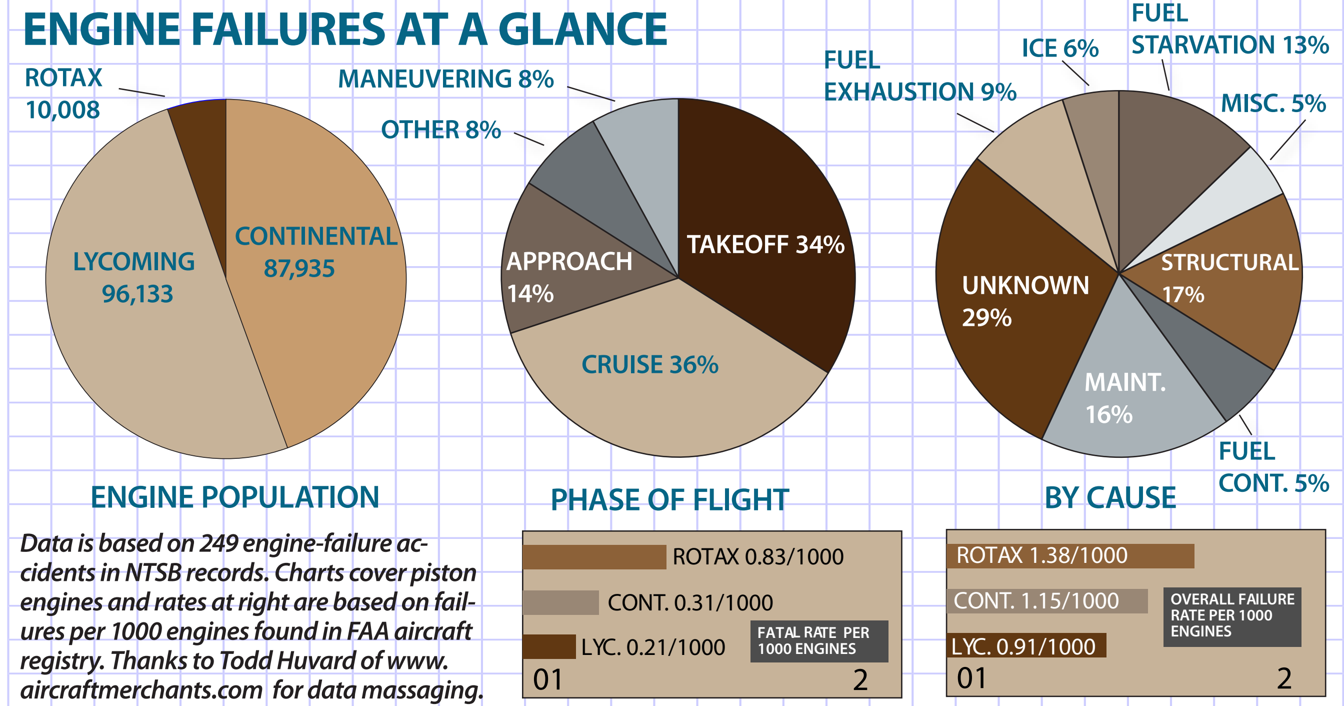
HOW WE DID THIS

We reviewed six years' worth of NTSB accident data, culling the engine failure accidents. We examined 2001 to 2002 and 2014 to 2016 to see if any trends had changed. Some caveats. Not all engine failures get into the accident database because not all of them lead to accidents. Even some that do end in crashes aren't recorded. So the data we used is the best available, if compromised.

Also, as is illustrated in the graphics, a large percentage of engine failures have an unknown cause, leading to some doubt if the engine failed at all. We're taking the report data at face value here. Last, we used the FAA's aircraft registration database to estimate engine population by type. This is a moving target since engine population changes by year, but we couldn't accurately sort the data by yearly change. Its accuracy is further diminished by inconsistent model nomenclature and coding. Again, we're using the best-available data.

C VS L

Our data sweep included only U.S. accidents and although we focused on Continental and Lycoming because they're the big gorillas, we looked at everything else, too, including turbines. The review turns up a surprisingly large number of engines that aren't Continental or Lycoming. Nonetheless, according to FAA data, Lycoming has a slight edge on engine population, about 96,000 for Lycoming, compared to 88,000 for Continental. Continental seems to own the large-dis-



Data is based on 249 engine-failure accidents in NTSB records. Charts cover piston engines and rates at right are based on failures per 1000 engines found in FAA aircraft registry. Thanks to Todd Huvard of www.aircraftmerchants.com for data massaging.

placement market. There are more O-520s and O-550s than there are O-540s. Lycoming is dominant in the mid-horsepower segment with its ever-popular O-320 and O-360 middleweights, a market slice where Continental never competed effectively. Thanks to a swarm of Cessna 150s still flying, Continental has strong presence in the small displacement end with the O-200.

The top-line look at engine failures reveals a measurable disparity between Lycoming and Continental. On a failure rate per 1000 engines, our data shows that Continental has an overall rate of 1.15 failures per 1000 engines compared to 0.91/1000 for Lycoming. So even though Lycoming has more engines flying, the failure rate is lower than that for Continental. We have a theory to explain this.

Large-displacement high-output engines fail at a higher rate than do their smaller displacement brethren. And because Continental has more of those in the field—twice as many, it turns out—it may have more exposure and thus more failures.

For both brands, large-displacement engines are overrepresented in the failure data. For Continental, for instance, 46 percent of its engines are large displacement, but these represent 60 percent of the failures. For Lycoming, it's 15 and 25 percent, respectively. (For reference, we used 400 cubic inches as the cutoff; Continental has a lot of O-470s flying and while Lycoming has the O-435, you've probably never heard of it, since it was mostly a helicopter engine.)

Increasingly, Rotax is a player in the U.S. market, although its share is a fraction of the two majors. Rotax has more than 10,000 engines on the registry, but only about a third of those were the 912 and 914 four-cylinders we were interested in. Based on our data, the overall Rotax failure rate is 1.38/1000. And here a warning about small numbers; an accident or two can sway the rate substantially. Rotax hasn't had many accidents, but it fields a smaller number of engines, too.

WHERE THEY HAPPEN

Accepted wisdom once had it that most power failures happen at the first power change after takeoff. This was long ago debunked, but there's still truth to it. Our survey found that a third of power failures occur during or shortly after takeoff. Slightly more happen during cruise, which makes sense since you spend more time doing that than taking off or landing.

A power failure in either phase of flight is likely to be equally fatal; 30 percent end in fatalities. The fatal probability is lower for approach-phase engine failures and we have a theory on that, too.

We don't have any data on how many multi-engine pilots take care of business and return to the airport after an engine tanks because these may be rarely reported. We do know from the accident reports that many engine failures in twins live up to the black joke about the second engine getting the airplane to the scene of the crash.

A few of these are spectacular VMC rollovers, but more are simply crashes into trees, terrain or airport fences because on a good day, light and medium twins can barely climb on one engine and losing one is the definition of a bad day. Fuel mismanagement also surfaces as a problem in twins.

For both Continental and Lycoming, single-engine failures are more survivable than twin-engine failures by a wide margin. For both Lycoming and Continental, engine failures in twins are twice as likely to be fatal as a failure in a single-engine airplane. That said, engine failures in single-engine airplanes all too often result in a stall, mush, spin or other loss of control.

Now the theory: Failures during approaches or descents typically happen at higher airspeeds and lower angles of attack, giving the pilot more options to respond. On takeoff, speeds are typically slow at

Fuel plumbing, like the Cessna 310, left, is a source of confusion for pilots.

high AoA and many pilots struggle to pitch the nose over to avoid a stall or spin.

WHY THEY HAPPEN

If there's anything scandalous about our findings it would be how many engine-failure accidents are of unknown causes. The NSTB reports show that 30 percent of engine failures that led to accidents have no known cause. In the Lycoming data, it's far worse: 41 percent were listed as cause unknown.

In our view, the NTSB investigations are uneven in their detail and thoroughness and in many cases, the agency doesn't send an investigator but relies on the FAA to complete the accident probe. In a podcast interview for our sister publication, www.avweb.com, NTSB vice-chairman Bruce Landsberg said that engine investigations are a weak point.

"It's our largest uncleared area. All of the regional investigators are signed up to go the Transportation Safety Institute in Oklahoma City for an in-depth program on recip engine design, construction and failure points and what to look for after a crash. We know we had a weakness there and we are finally doing something about it," Landsberg said.

From what investigatory data is available, some patterns are discernible. First, more than a quarter (27 percent) of engine-failure crashes are caused by preventable fuel problems: exhaustion, mismanagement or contamination. Misfueling comes up, but it's rare.

Less rare are bona fide structural failures in which something serious breaks—a connecting rod, a crank, a valve or camshaft. Structural failures account for 17 percent of the engine failures we examined, with more of them happening in Continental than in Lycoming engines.

Occasionally, the engines get a little help from inept mechanics. In 11 percent of the failures, errors by maintainers were cited. Under-torquing of fasteners—cylinder through bolts, rod nuts, fuel pumps, accessory case hardware—are some examples. In fact, several of the catastrophic failures we found consisted of spun main bearings that damaged crankshafts or connecting rods because of improper torquing following cylinder removal and related work.

Although this trend doesn't appear to be epidemic, it has been noticed by Savvy Aviation's Mike Busch, whose owner advisory service tracks hundreds of aircraft in the field. He recommends not torque-relieving more than one pair of through bolts at one time and not rotating the crankshaft when the work is done. Continental engines are particularly susceptible.

"The rod bolts are the most highly stressed fasteners in the engine, and getting the proper preload on them is absolutely crucial. Most Lycoming rod bolts are torqued to stretch using a micrometer, so their preload is usually pretty accurate. Continental engines, however, have their rod bolts tightened using the torque method, which is fraught with peril and very difficult to perform correctly when the case isn't split, especially with access from only one side of the engine," Busch told us in an email.

TAKEAWAYS

While the risk of an engine failure is relatively low, it can be reduced by heeding patterns we see in the accident reports. Carrying enough fuel should be a no-brainer, as is religiously checking it for contamination before flight. If you're obsessive, let the tanks settle for 15 minutes before sumping them after adding fuel. In our survey, we found 25 accidents in which pilots crashed perfectly airworthy airplanes with usable fuel in tanks that they couldn't figure out how to access. At least three of these led to dual engine failures in twins and two were major fatal accidents killing all aboard simply because of the pilot's ignorance of the fuel system. Single-engine airplanes aren't immune. Fifteen of the 25 fuel starvation accidents occurred in singles, which typically have simpler fuel systems. Induction icing doesn't loom large as an accident cause, but it too is avoidable. In a dozen wrecks, pilots lost the engine because they forgot to use carburetor heat at reduced power settings or when descending. Continental's O-200 and O-470 are especially susceptible to carb icing. In fuel-injected engines, know where the alternate air source control is and when to use it.

Avoiding maintenance-induced stoppages is more difficult. You hire an A&P because he's supposed to know how to fix the engine and let's be fair here and say that the vast majority are competent at the job. But enough mistakes are made to reveal a discernible pattern of errors that caused more than 20 engines to quit. In our view, that's not a trivial risk. Deferred maintenance has caused a handful of accidents, including failing to replace aged-out hoses or questionable fittings and failing to do required magneto maintenance. That said, if maintained, magnetos appear to be as reliable as reputed, and were cited only twice as a cause of engine-failure accidents.

Training figures into this, in our view, less for twins than singles. Preparing to respond to an engine failure after takeoff and in cruise should be a routine part of every pilot's recurrent training, not just on a 24-month flight review. Stall/spins in these situations are all too common. The challenge for twin-engine pilots is different by degree and it's not just going through the fire drill of identifying and caging the bad engine, but accepting that the airplane won't actually climb on one engine and making the best of putting it on the ground somewhere. At least two pilots—one a designated examiner seizing control of the airplane from an applicant—did exactly this and lived to fly another day. It's a lesson we should all take to heart.

THE 30-MINUTE PREFLIGHT

If your airplane doesn't get an oil change between annuals—and many don't—it's likely that the engine cowl stays put for an entire year. Your only view of the engine room might be through the oil access door or the inlets.

Although our review of the accident record doesn't reveal engine failure as a high risk, it's still a risk and some failures could have been prevented through simple engine inspection.

On my Cub—now entering its 82nd year of service—about every 10th flight I remove the top and bottom cowl, grab a flashlight and a rag and have at it for 10 or 15 minutes of minute inspection, with another 15 minutes reserved for the rest of the airplane. Based on mechanical failures our research revealed, here are some things to check.

Oil and fuel fittings and lines— These come loose or chafe and if they're old, the outer layers become brittle and cracked. If you have an oil cooler, check the inlet and outlet fittings for cracking.

Cylinder bases— Are all the nuts in place? I once found one missing on a four-cylinder Lycoming. Check the base-to-crankcase mating for signs of oil weepage. And have a look at the crankcase split for signs of excess weeping.

Rocker box covers— Are all the screws in place and tight? These screws sometimes have drilled heads for safety wiring but I don't see that done very often. Some have star washers and those should be in place. A loose screw or two can cause enough oil loss to, at minimum, trash the engine compartment. At worst, cause a fire or loss of lubrication.

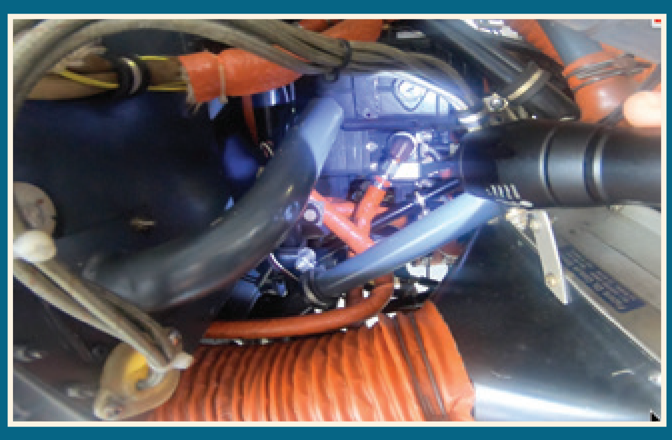
Check the pushrod tube seals for leakage at both the cylinder head and crankcase end. Also, is the oil filter safety wired and is there any leakage around the base?

Magnetos— Simple as they are, magnetos rarely fail, but more often, they simply fall off the engine for lack of secure mounting. The Bendix dual magneto found on some Lycomings is notorious for this. Give the magneto a shake to assure its security. And remind yourself to do a P-lead check by shutting the engine off with the ignition switch. If it doesn't quit, the P-lead is open.

Ignition leads—We didn't see any of these implicated in accidents, but nonetheless check that they're properly routed, secure and not chafing. And remind yourself to check when they were last replaced.

Alternators—Alternator failures might not lead to engine failures, but have resulted in accidents due to loss of instruments and nav equipment. In one fatal accident, a Continental alternator drive coupling failed and pieces of it tanked the entire engine. The part can't see seen on preflight, but belts driving alternators can be, as can the security of belt and accessory case-mounted alternators.

Turbochargers— If you have one, check the oil lines for security and leakage, with special attention to the fittings. Give the thing a shake to see if it's secure and check the exhaust plumbing for any signs of leakage, as evidenced by gray streaking. If in doubt, have an A&P check it. Give the cold side induction hoses a careful look, with special attention to the clamps. If one blows off—a fairly common occurrence—it won't fail the engine, but it will get your attention, especially at high altitude.



Throttle, mixture, prop and carb heat cables— These are among the most bulletproof components in the engine compartment, but when they fail, it's often because the cable end fitting or clamp screw comes undone. Check tightness with a wrench or screwdriver and if it's supposed to have a cotter pin, make sure it does. Check the carb heat box for cracking, a common wear point.

Fuel vents—These aren't in the engine compartment, but out on the wing where the tanks are. Insects love to clog them with mud and dirt and one or two such incidents turn up in every accident sweep we do. It can be an acute problem for aircraft stored outside.

Air filter—They don't last forever even though owners seem to think they do. Shreds of ancient paper air filters have choked an engine or two, so make sure yours is sound and maybe installed after the turn of the last century.

Baffling— Although not implicated in any engine stoppages, engine cooling baffling often doesn't get the attention it needs and some of it is pretty ratty. If yours is, just replace it. It's not expensive and the engine will run better for it.

If all of these things seem obvious, they apparently were not to the pilots who suffered engine stoppages because they failed to simply check them on preflight. If in doubt, leave the engine uncowled and have an A&P give it a once-over.—*Paul Bertorelli*

Used Composite Buys: Inspection Mandatory

Forget what you know about inspecting a metal airframe. What lurks beneath the shiny skin of an aging composite airplane may be a deal breaker.

by Randy Dufault and Larry Anglisano

Everyone knows that buying a used airplane involves a level of risk, and despite the requirements for record keeping and mandatory annual inspections any number of significant gremlins can hide within the airframe. The risk increases substantially with an aging composite structure.

Face it, while aluminum aircraft still dominate the fleet, composite construction represents a rapidly growing portion of the for-sale options. With the first London, Ontario-produced Diamond DA20s leaving the line in 1995 and the first Cirrus SR20 flying out of Duluth in 1999—hundreds, if not thousands, of used examples are options for buyers looking for the sleek appearance and other desirable characteristics embedded in these composite designs.

But as a potential buyer your questions should be: What lies beneath the glossy gel coat, is there hidden damage that will surface during the next annual inspection and after your check has cleared, and were all repairs done per the maintenance manual?

For this article we talked with shops, sales pros and aircraft manufacturers who weighed in with advice for shopping the used composite aircraft market and major items to look for during a prepurchase inspection.

VERSUS METAL

Notwithstanding deep problems like cracked spars and hidden corrosion, on a metal airframe identifying airframe issues is reasonably straightforward. Not so much with composites, which starts at the surface with critical paint considerations.

Coatings are a major component of a composite structure. Ultraviolet radiation, a significant part of what the star closest to our home planet emits, can quickly degrade the resins used in bonding the various components that make up a composite part. Some resins also respond poorly to heat.

"You've seen lots of aluminum airplanes where the paint is just faded away or not even present," Chris Eichman, an owner of Cirrus sales specialist Aerista, said.

CHECKLIST

+ In general, composite structures are durable and reasonably easy to maintain.

+ Older yet modern composite aircraft are on the market for reasonable prices.

But hidden damage and improper structural repairs may be tough to spot until it's too late.

As Eichman pointed out, what is acceptable and airworthy on the surface of a Bonanza isn't really the case on composite plane. The paint has to be in good condition in order to provide the UV protection properties.

Eichman went on to add that there are restrictions on how one can apply paint and other finishes. Cirrus and the other manufacturers of composite planes have specific rules about the paint product itself, about the colors and about the placement of colors on the airplane.

"There is a reason you've never seen a black Cirrus—in fact, there is a reason you've never seen a Cirrus

Modern and well-cared-for composite aircraft like the 2004 Columbia in the main image are worth considering, but only after a focused inspection.

with black stripes above the bottom of the windows," he said.

But some models on the market sport new and modern paint work that they didn't have when they rolled off the assembly line, and they deserve a closer look. Early on, Cirrus buyers could order their airplanes in any color they wanted, as long as it was white. That's because of an FAA-imposed limitation for fear that darker colors would absorb more heat and more quickly deteriorate the composite structure. But as time went on, darker colors were allowed, and the aftermarket followed with its own paint work.

Aerista has encountered composite airplanes for sale coated with the wrong paint or with paint schemes violating the manufacturer's specifications on color or color placement. The only acceptable mitigation for a craft in that condition, likely at great expense, is complete removal of the paint and application of a conforming finish.

Resins in areas of a composite plane exposed to the sun due to eroded or missing paint will dry out and cause a delamination (more on delamination later). Repair of such damage is straightforward, but does come at a cost. One idiosyncrasy of at least some composite models is cracks in the paint.

"People will often assume that means there is a crack in the underlying structure," Eichman said. "A crack in the composite is something that can be tested for very easily. I can't think of a time when we've seen a crack that has been anything other than cosmetic."

That's a bird strike to the leading edge of a Cirrus in the top photo. Surface cracks don't always mean structural damage. It takes sizable disassembly to spot damage that lurks deep in a composite airframe, bottom. That isn't always practical during a prepurchase evaluation.

IMPROPER REPAIRS

The FAA conducted a case study of five improperly done composite repairs. Granted the repairs were for commercial airliner parts, but the issues aren't much different for GA aircraft. The study found instances of FAA repair stations using the wrong materials, not using the proper tooling, not following the manufacturer's instructions for assembly, exceeding repair size limits and even using procedures specified for an entirely different aircraft. The result was always an unairworthy part that may not look any different from a properly repaired one.

Andrew Moonilal, a technical support specialist at Diamond Aircraft's London, Ontario, plant, said Diamond finds things that were (or weren't) done to its aircraft that deviate from what it considers to be an approved status. "We have worked backward to remove repairs and recertify the airplane back to our standards," he said of these so-called repairs.

Darryl Taylor, general manager of Air Power Inc. and a noted expert on Cessna Corvalis and its predecessor Columbia models, gets concerned when an aircraft's logs indicate major repairs that happened without the involvement of the aircraft's manufacturer.

Taylor told us that every now and then he sees major repairs that were signed off on an FAA Form 337 (which in the eyes of the FAA is indeed a major repair and/or alteration) by a local designated engineering representative (DER). According to him, buyers might stay away from these planes just because support from Textron Cessna is questionable, and that greatly reduces the aircraft's value. On the

Repainting composites, top, is different than metal and something to look for in the records. A backwoods composite taildragger on floats like the well-supported Carbon Cub, bottom, is bound to need even minor composite repairs in its service life. OEM support should play a role in the buying decision.

other hand, we've seen some structural repairs (signed off by a DER) that were as good as what the OEM turned out. The key is good documentation of the work, and a good inspection to vouch for it.

Speaking of good documentation, that's what often happens at Diamond. When notified of an event causing significant damage to one of its airplanes, Diamond's technical support and engineering organizations develop a Repair Design Approval (RDA). The RDA is an explicit set of specifications, instructions and procedures for returning the airplane back to an airworthy condition. It also becomes a permanent part of the aircraft's history.

Moonilal at Diamond said its repairs are meant to be done in the field without any special equipment, and a lot of composite repairs use a combination of heat and vacuum bagging, which is what is done in the manufacturing process.

"But when we engineer a repair, it's such that there is no need for vacuum bagging in probably 99 percent of the cases. You just lay up the layers of glass, foam or carbon and apply heat at a certain temperature to cure the resins," he said.

DELAMINATION

Composite structures are just that. They are composed of different materials bonded together with resins, usually in layers. Any component of the composite "sandwich" can separate from an adjacent layer, creating a void and a subsequent structural problem. This is delamination, or in some cases, debonding.

The basic test for delamination is remarkably simple. A technician taps the structure with a coin or other small metal instrument and listens for differences in the sound the tap produces. A duller returned sound may indicate the presence of delamination and indicate a need for repair. More advanced non-destructive testing techniques, like ultrasound inspection, can confirm the presence and extent of the damage.

Diamond's Moonilal pointed out that any airplane in their certified pre-owned program gets a complete nose-to-tail, wingtip-to-wingtip examination, and delamination is high on the list of the things to look for.

"One of the things we cover with the MSI (major structural inspection) is a tap test," adding that it includes tapping the entire airframe—looking and listening for delamination between the layers of glass or carbon. If Diamond suspects something isn't quite right, it will remove the paint and primer from that area and inspect the composite structure by any means necessary.

MSI is a recurring requirement for many of Diamond's aircraft. For example, the DA40 requires an MSI after 2000 hours of service and one every 2000 hours after that. The DA62 twin requires its first MSI after 6000 hours with repetition at subsequent 4000-hour intervals.

Cessna has a similar recurring requirement at 3000-hour intervals. "There are a few airplanes out there that are over the 3000-hour mark, and although we have never done one at Air Power, my best guesstimate is that it is going to add about 25 hours to the annual inspection that particular year, plus discrepancies," Taylor said.

What may be more important is how a delamination occurred. The case of issues created by poorly maintained paint mentioned earlier are relatively straightforward and easily repaired. Other causes may create a larger concern.

"Typically, delamination is a sign of unusual loading of the composite structure. Unusual bending usually causes delamination or debonding of parts of airplanes," Moonilal said.

Obviously, a delamination issue, possibly caused by abnormal loading, is reason for further examination and understanding. While the damage is likely repairable—particularly if there are no visible deformities in the structure—what sort of regular service or unusual incident caused the problem in the first place? The recent NTSB report on a fatal Embry-Riddle Aeronautical University Piper Arrow crash confirms that an unusual service life (like training)

can impact an airframe in unexpected ways. Plenty of used-market composite models have lived hard lives on training lines.

LIFE LIMITS

Most general aviation aluminum airframes' type certificates do not carry either an age-related or service-related life limit. There are exceptions, but if owners maintain the craft in a fashion consistent with the manufacturer's specifications, and manage and attend to any corrosion, the basic airframe should last forever.

Things are different for the composite designs. Their type certificates include specific lifetime limits and/or required major inspections.

Cirrus is seemingly the most restrictive with an airframe life limit of 12,000 hours. With the first airplanes introduced in 1999, it is possible for airplanes, particularly ones that served as trainers or in other fleet situations, to be approaching that magic number. An individual owner flying about 100 hours a year is not going to add time up to those sorts of hours very quickly, but the limit is a purchase consideration.

A web post from Cirrus' engineering organization says as the fleet begins to approach that number, a combination of further testing, analysis and inspection may extend the 12,000-hour figure.

Textron Cessna's limit on the Corvalis (formerly Columbia) models is 25,200 hours, more than double the Cirrus value. As Darryl Taylor pointed out, no aircraft in the fleet has amassed anywhere near that amount of time, but as mentioned the airplane does require the 3000-hour inspection.

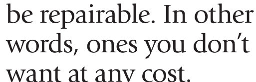
Diamond's type certificates, like most type certificates for aluminum airplanes, do not specify an airframe life limit. However, like the Corvalis, major inspections at defined intervals are part of required maintenance.

FRANKENSTEIN AIRPLANES

The FARs allow for the repair of virtually any aircraft, from parts in any condition. If an A&P follows the rules, takes care of the paperwork and an IA signs everything off, the regulations deem the aircraft airworthy. Often components of several airframes combine to make an airplane that may or may not be all that it seems, or all it is represented to be.

The good news in that the manufacturers maintain lists of airframe serial numbers they believe have sustained damage beyond what they considered to be repairable. In other words, ones you don't want at any cost.

Avionics work often means antenna work, a process that should be well documented in the aircraft records. That's an in-progress repair to a composite wingtip in the middle photo. There's considerable composite work required to gain access and repack the CAPS parachute in a first-gen Cirrus, bottom.



"There are serial numbers that are not supported by the factory for a variety of reasons," Eichman said. "That includes planes that have been destroyed in a crash, but there also are planes out there that have been crashed, damaged and put back together in a Frankenstein way."

A call to the factory line prior to a purchase can ensure that it still fully supports the prospective serial number.

It is interesting that parachute deployments on Cirrus airplanes do not necessarily land them on the list. "There are plenty of parachute-deployed airplanes that have been legitimately repaired and are back in service and fully supported by Cirrus," Eichman said.

On the topic of whole-airplane parachutes, it's worth mentioning that first-generation Cirrus models require substantial composite and paint work during the required 10-year repack. That's because accessing the CAPS means breaking the

THE COMPOSITE ADVANTAGE

Undeniably, a distinct advantage for any purchaser of a pre-owned composite plane is that they all are relatively young, at least compared to the average age of the aluminum airplane fleet. In many cases these airplanes have relatively few hours of total time and are still in factory paint, and many are stored in climate-controlled hangars. Plus there simply has been less time for something bad to have happened to them.

Another obvious advantage is that corrosion is essentially unheard of in a composite airframe. Sure, some non-composite accessories will corrode, but it just isn't the major concern for a buyer compared to shopping for, say, a Comanche or vintage Bonanza, to name two all-metal machines.

As Cirrus pro Chris Eichman pointed out, the control surfaces on an SR20 and SR22 are aluminum and little stuff like boarding steps and handles and things like that can corrode, but typically those things are not structural. All of the plane's structure is composite and therefore can't corrode.

Ultimately the biggest issues with a composite airplane purchase will exist forward of the firewall, just like it is with any other airplane. That is where the costly parts and repairs reside. But the potential does exist for problems in the airframe and those problems are different. However, with the right advice and inspection, a pre-owned composite aircraft could make for a satisfying ownership experience. They're strong, they look modern and most have favorable resale values compared to some metal airplanes.

fiberglass in the upper area of the fuselage, aft of the rear window. We covered the entire costly process in a field report back in the December 2012 issue of *Aviation Consumer.*

EXPERTS MATTER

Involving the right expertise in the buying process for a pre-owned composite airplane is incredibly important, but unfortunately it doesn't always happen.

"I'm a big fan of expertise," Air Power's Darryl Taylor said, making the good point that a particular A&P/IA or repair station cannot be an expert in all piston single- and twin-engine airplanes—metal or composite. But as for composites in particular, there are a handful of shops that just know these airplanes inside and out, and of course that generally includes factory authorized service centers. They have access to the approved parts network, service bulletins, service manuals, training and support from the factory.

That's why it's not uncommon for aircraft that have been cared for by these shops their entire life (with logbook entries as proof) to carry a price premium. But that still doesn't mean the prepurchase evaluation should be shortchanged.

Taylor went on to say that he does not think twice about damage repaired by a shop he knows to be skilled in the Corvalis/Columbia line. Work done by other shops may be safe and airworthy, but his shop has seen issues when conducting an annual or other service on those planes.

It's one of many reasons why you simply need to have the airplane inspected by a shop that's skilled with both composite repairs and maintaining the model you're ready to call your own.

Contributor Randy Dufault is a longtime freelance aviation author and an instrument-rated pilot who owns part of a Cirrus.

COMPOSITE SHOPPING CHECKLIST

- ✔ Start with a close look at the maintenance logbooks.
- ✔ Check the aircraft's serial number with the manufacturer.
- ✔ If they consider it beyond repair, walk away.
- ✔ Closely inspect avionics/antenna work and documentation.
- ✔ Aftermarket paint? Ensure it still meets OEM specs.
- ✔ Pay particular attention to delamination.
- ✔ Fuel leaks could be a sign of cracks in or around the tank.
- ✔ Avoid models with signs of excessive sun damage.
- ✔ Surface cracks aren't a deal breaker, but worth a close look.
- ✔ Consider required inspection intervals on older airframes.
- ✔ Were repairs made with the factory's technical approval?

REPAIRS: FACTORY INVOLVEMENT MATTERS

Just like with metal airplanes there are a lot of things that can damage a composite one. Maybe it took an impact during ground handling, or a wildlife strike on the runway, or perhaps it's dreaded hail damage, which requires lots of little (well, maybe big) repairs to the fuselage and control surfaces. Hey, stuff happens, and spotting these repairs—and how they were handled—is what you're looking for when you're shopping.

During our research we talked with Paul New at Tennessee Aircraft Services in Jackson, Tennessee, who specializes in major structural repairs to both metal and composite aircraft. New was handling the composite repair of a hail-damaged Cessna (Columbia) 300 in a way every buyer (and owner) would want, partly because Textron is involved in the process. The repair process for this Columbia—particularly the paperwork chase—is a poster child of how it should be done, in our view. The factory guidance is a Repair Definition.

New's repair started with a detailed damage report sent to Textron, which will review the 27 impact points from the hail strikes that he found during his inspection. As New described it, every one of those impact points is considered a separate repair. The potential gotcha is that in certain areas of the structure, the number of repairs that are allowed is limited. Plus, repairs must not be too close in proximity to each other or they constitute a single and much larger repair. Here's where the factory's record-keeping is important because Textron maintains a structural map of all known repairs made to a particular composite Columbia, Corvalis and TTx series aircraft (all discontinued, of course, but still supported). These repair records will help determine if a new repair

will encroach on any previous ones.

We attest that there are plenty of skilled composite shops that aren't Textron, Cirrus or Diamond (to name a few models) service centers. On the other hand, if someone sidesteps the factory's engineering of the repair (even when using a DER to orchestrate it and sign it off), they may be performing repairs in areas with previous damage and actually end up creating new structural issues. Moreover, a composite field repair made with assistance from the factory means there will be good records to support the repair, which should help the resale value.

As complicated as a composite structural repair seems, don't overthink what's really going on from a damage-repair standpoint. Or underestimate the skill and environmentally controlled shop space that's needed to fix composite aircraft to like-new condition. Since composite structures have several layers of glass and cloth that must stay bonded together, almost any damage to the structure (beyond cosmetic) of a composite aircraft includes the separation of these critical layers. Perhaps overly simplified, it's a sand, fill and paint process, albeit a pretty critical one.

New told us that for structural repairs to the Columbia, the Textron lab backstops it and gets a sample of a cured stamp (usually a bonded sandwich of structure) to verify that the resin was mixed and cured properly, and that the overall bonding mixture meets the correct specifications for structural integrity. The job isn't finished until Textron essentially approves the field repair (and issues lab reports) and the shop signs an FAA Form 337 that's kept with the aircraft records. The factory Repair Definition is considered approved data.

"Unlike metal airplanes, repairs to composite structure can be really difficult to spot, which is why I pay close attention to any composite airplane that comes in for a prepurchase evaluation," New told us.

And that's part of the takeaway. The inspection really needs to be done by someone who knows what they're looking for. If the paperwork doesn't reveal prior damage, a trained eye will. If the factory was involved and issued a Repair Definition, it was likely a good fix.

CHECKLIST

Non-owned policies for flying flight school aircraft are affordable—some as low as $80 per year.

But, it may not be enough. Read the policy carefully and understand the aircraft rental agreement.

You could be paying a high deductible for your share of the damage.

Renter's Insurance: Affordable, But Limited

Non-owned liability insurance policies generally lack the limits needed to cover serious injuries. Don't rely on a flight school's policy alone.

by Jon Doolittle

Interestingly, the number of U.S.-registered aircraft is increasing, while the number of pilots is decreasing. (Wikipedia says there were 609,306 licensed pilots and GAMA counted 211,000 registered aircraft.) But even allowing for flying clubs, partnerships and the graying and thinning of the pilot population, this still means that there are a lot of pilots who are flying aircraft that they do not own.

If you are one of them, this article—a fresh look at non-owned aircraft liability insurance coverage—is for you. Truth is, to understand what sort of coverage different types of pilots need, it helps to know what they are already covered for, and what they are not. Here's a primer for shopping.

A DIVERSE POPULATION

Some of the nearly 610,000 pilots are following the siren song of future airline jobs. Others are the growing numbers of CFIs who are providing that flight instruction. Some are pilots hired by an owner to ferry the airplane, pilots test flying airplanes after maintenance and sales demo pilots. And finally, there are a large number of pilots who are simply borrowing a friend's airplane (or helicopter) and are reimbursing the owner in some way. Some are using other folks' aircraft under some form of dry lease. Almost all of these pilots need some form of liability coverage, what insurance people refer to as non-owned aircraft liability insurance, or more simply, renter's insurance.

When it comes to pilots flying aircraft that they do not own, it is useful to divide the universe into two parts: pilots who are being paid to be in that aircraft because they are working in one way or another, and pilots who are in that airplane for pleasure and business (non-commercial) purposes with the owner's permission.

Pilots who are using the aircraft with the owner's permission, and who are not acting as professionals at the time of the accident, will receive virtually the same insurance protection that the owner does. The aircraft liability, in most cases, will protect the permissive user against suits for injury to passengers or people on the ground as well as damage to property.

On the other hand, pilots who are being paid to fly the airplane—like flight instructors and ferry pilots who are providing dual flight instruction or pilot services at the time—are probably not covered for anything under the aircraft owner's insurance unless special arrangements have been made. Professional pilots who are flying in customer aircraft are typically not covered for bodily injury liability or for damage to property or for damage that they cause to the airplane unless special arrangements have been made in advance.

If someone in the aircraft or on the ground is injured, and it was alleged to be the fault of the pro pilot, he or she will likely be sued. On the other hand, CFIs providing dual instruction in airplanes that belong to their employer probably will be treated as employees, and will be protected by the flight school's policy.

Flight instructors also face the possibility of yet another threat: Years after signing off a pilot candidate, the CFI can be sued for "negligent instruction." These suits are fairly rare, but hiring a lawyer to defend yourself can be an unwelcome and expensive proposition. Some flight schools carry this coverage to protect their instructors, but many do not, and generally, the limits available are fairly low.

FLIGHT SCHOOL INSURANCE

A growing part of the pilot population is made up of renter pilots. Some of these are folks who don't want to take on the expense of owning an airplane on their own, or managing a partnership. Show up at the flight school on Sunday morning and check out the Cherokee—or tailwheel aerobat—for a couple of hours. But believe it or not, we are also seeing younger pilots who are getting their ratings in hopes of flying professionally.

For the true renter, it is important to understand some things about flight school insurance. Most flight schools carry fairly low limits of liability simply because the insurance is expensive. And often, flight school policies cover the flight school, but exclude coverage for the student or renter pilot. Read that again.

Moreover, many flight school policies have high deductibles on their physical damage coverage, and their rental agreements make it clear that the renter is expected to pay for any damage. Helicopter deductibles while the rotors are in motion can be as much as 10 percent of the value of the helicopter. You'll shell out real money. In many cases, the renter is also expected to pay for the school's loss of revenue while the aircraft is removed from service for repair.

If there's any hope of not going broke if you break someone else's aircraft, there are a number of insurers offering non-owned aircraft liability, plus a variety of additional coverages. Which one is best for you depends upon what kind of flying you do. No two of these policy forms are the same, although they do have similarities.

In most of them, Coverage A (or Coverage 1) is bodily injury and property damage liability and medical expenses, but does not include damage to the rented airplane. This coverage is the foundation coverage, and you need to purchase this one if you want to purchase any others. This protects the non-owned pilot in the event of a suit alleging that he or she acted negligently as pilot, and caused bodily injury or property damage to the plaintiff. This coverage is usually subject to a per accident limit of $500,000 to $1 million, in some cases $2 million. There typically is also a per person or per passenger limit of between $50,000 and $200,000.

A little hover-taxi practice on a windy winter day keeps the skills sharp, but know the deductible if you break it. Plain-vanilla Cherokees and 150s are easier.

In addition to the insurer paying off any court judgment or settlement, a large benefit of having liability insurance is that the insurer is required to investigate the claim, and to pay the cost of defending the claim. Without this, you would be left to pay for your own lawyer from the first dollar. The company's obligation to pay for your defense is without limit, and is in addition to your policy limit. As a rule however, the insurer's duty to pay for your defense ends when the insurer has agreed to pay the policy limit.

For this reason, we recommend that you consider buying the highest limit that they will sell you. This coverage should be considered by anyone who flies aircraft that he or she does not own. If you own an airplane or helicopter, you may find that your aircraft policy provides some coverage for occasional use of non-owned aircraft.

The second main coverage that can make up part of a non-owned aircraft liability is Coverage B, aircraft damage liability. This coverage is optional, and is typically sold with a per-occurrence limit, usually from $5,000 to $200,000. This is the coverage that will pay if you negligently damage an aircraft that you do not own. This is the coverage that you will need if your FBO requires you to cover his deductible.

Keep in mind that both of these coverages are liability coverages. There needs to be at least an allegation of negligence made against you. We strongly recommend that you never use non-owned liability coverage in place of (or without) physical damage coverage. Here is what can happen.

You are ferrying a friend's airplane, which has been sold. Unknown to you, the new owner has not placed insurance on the airplane. The engine quits and will not restart. You land in a field and walk away unhurt, but the airplane is a total loss. The engine failure wasn't

Flight schools and flying clubs with floatplanes and taildraggers are feeling the insurance pinch. Several told us they had to take these aircraft off the line because insurance was too expensive because renters broke them so frequently.

your fault, but who will replace the airplane? You were the PIC—and hopefully signed off in type.

GET ADDED TO THE POLICY

This so-called risk-management approach is if you are teaching in or regularly flying in aircraft that you do not own. If the owner and his insurer will agree, ask if you can be added to his insurance. There are three steps that are required.

Make certain that you either meet the pilot requirements or can be listed as a pilot by name. Request a certificate of insurance showing that with respect to instruction that you are included as an additional insured with respect to the owner's liability coverage. Also be sure you are provided with a waiver of subrogation with respect to physical damage to the aircraft, and are provided with a 30-day written notice of cancellation at your chosen address.

An advantage to this approach is that you may get more protection under the owner's insurance than you would be able to find on you own. Two disadvantages: The owner's insurer must agree to it, and it is impractical for a single flight, such as a flight review.

SHOPPING TIPS

If you are shopping for non-owned coverage here are things to consider.

• Look at each company's aircraft limitations. It sounds basic, but if a company does not cover what you fly, no sense in getting too deep into the weeds. If you fly seaplanes, homebuilts, gliders or helicopters, you may only have one or two choices. Make sure that you understand what the insurer requires in the way of official paperwork. If you are flying experimental airplanes, make sure that the insurer will cover these.

• Some companies offer coverage that pays the aircraft owner's deductible regardless of fault. If the rental agreement that you sign each time you fly makes you responsible for the deductible, this becomes important

• Some insurers broaden the definition of a non-owned aircraft to include flying club airplanes, provided you do not own more than 20 to 25 percent of the airplane. If you are an owner and are concerned about not having enough liability limit, this might be a way to get it.

• If you are a CFI, look carefully at possible offerings. Avemco has an affinity program with NAFI. C.V. Starr has a similar program with SAFE. Global has non-owned programs with Sporty's and with EAA, and there's Assured Partners Aerospace with AOPA. Make sure that whoever you choose covers your signoffs, and under what conditions. For example, do you need to continue coverage in order to be protected if one of your signoffs from years ago has a problem and claims that you failed to adequately instruct her on lowering the landing gear?

• If you plan to fly non-owned aircraft on behalf of your employer, make certain that the insurer that you pick will offer to add your employer as an additional insured, and make sure that your employer will accept the limit that the non-owned underwriter will provide.

• If you are flying an airplane under a dry lease or similar agreement, check your policy wording. Typically, if the term of the agreement exceeds 30 consecutive lease periods, it is treated as if you owned the airplane, and not covered.

CONCLUSION

Non-owned aircraft coverage is relatively affordable. It's widely available, and there are a number of companies offering it, including Avemco (www.avemco.com), AIG (www.aig.com), Global Aerospace (www.global-aero.com), QBE (www.qbe.com), Americas (www.americas-insurance.com) and C.V. Starr Insurance (www.starrcompanies.com). You can compare coverages on most of these sites and they have portals that allow the consumer to shop and buy online.

Most underwriters that spoke with us said that rates for non-owned coverages have held steady despite the gyrations of the rest of the aviation insurance market. If there is a problem with the non-owned market, it continues to be the lack of available limits. For the most part, the highest limit that you can get is $200,000, and possibly only $100,000.

We don't feel like that is enough to take care of a serious light airplane accident injury, but perhaps that is the way to cut down on aviation accident suits.

Jon Doolittle is an aviation insurance expert and a broker at Sutton James, an Optisure Risk Partner, based at Hartford Brainard Airport in Connecticut.

With excellent handling, the PT-6-powered, 250-knot Cessna 425 is one of the most popular owner-flown turboprops.

AIRCRAFT UPKEEP

Aircraft Management: Ownership Simplified

Frustrated with the complexities of maintenance requirements, insurance and training on your turboprop or jet? An aircraft manager may help.

by Rick Durden

There it is. Right there on the ramp in front of you. You finally pulled it off. You've wanted a turboprop—no, that turboprop—ever since you saw one a few days after you soloed. Now, look at yourself. You just closed on the purchase of that Cessna 425. That one, with the incredibly cool four-bladed prop mod. The one that's currently overwhelming your senses.

NOW WHAT?

You've owned and flown a succession of piston singles and twins. You work 60 hours a week—conservative estimate—and you've had trouble in the past working a flight review into your schedule every two years. The local shop has looked after your airplanes, fixing them when they broke and giving you a nudge when it was time for an oil change or an annual.

But this has engines that go "whoosh," and you're vaguely aware that turbine means different maintenance regulations and requirements and you've got voicemails and texts from your insurance agent reminding you that you can't fly your new hot rod until you finish simulator-based training. You've climbed the mountain and bought the airplane of your dreams—but suddenly the details involved with actually flying it seem overwhelming. Where do you go from here?

We're hoping that new turboprop and owner-flown jet buyers don't get that far into the transaction without having a firm handle on what's involved with the complexities of owning and operating those capable machines. Turbine-powered airplanes have the potential to give owner pilots new levels of speed, range and ability to safely handle weather than is possible in most piston pounders.

The tradeoff is a corresponding jump in operational costs and considerations. As one owner told us, "It takes a fair amount of mishandling for a pilot to damage a $40,000 piston engine, but with one screwup during starting a pilot can trash a half-million-dollar turbine engine in a matter of seconds."

In real-world terms, the combination of capability, cost and complexity of turbine-powered airplanes has led to the appearance of numerous companies and individuals that specialize in managing those airplanes for their owners. Management companies will do the heavy lifting involved with ensuring that the airplane is properly maintained and insured and the owner-pilot is scheduled in for the training her or his insurer will mandate—for a fee.

Based on our research for this article as well as flying turbine airplanes for over 40 years, we'll say up front that if you have the wherewithal to buy a turboprop or owner-flown jet, you probably don't have the time to commit to keeping track of the sheer volume of paperwork involved with keeping the airplane safe, legal and insured.

Put simply, turbine engines mean dealing with matters that you probably never wrestled with piston engines such as time and cycle limits for components, more stringent regs regarding maintenance, manufacturer's service instructions that may be mandatory rather than advisory and insurance requirements that are complex enough that failure to comply may mean no coverage if you bend the airplane.

Kasey Lindsay, one of the principals of Northwest Jet, an aircraft broker in Boise, Idaho, told us that it takes as much as 10 hours a week for a person to manage all of the maintenance requirements for a small jet.

That's where aircraft managers step in and earn their fees. And, based on our research, the time to get one involved is before you buy the airplane.

WHAT DO YOU WANT?

We've said it time and again: Before

CHECKLIST

A good aircraft manager will let you focus on flying your airplane.

An aircraft manager will get you flying when you break down on the road.

A manager should not charge you a fee for parts or maintenance work.

You bought that Cessna 425 Conquest I of your dreams, above; a professional aircraft manager can significantly reduce the day-to-day challenges of keeping it maintained. Should you decide to lease your new PC-12 to generate charter revenue, below, you'll need someone to manage the requirements of Part 135 compliance.

you make the decision to buy any airplane, figure out exactly what it is you want from that purchase. Not being able to state that clearly can mean a lot of wasted money. When it comes to turbines, cube the amount of money involved.

For almost all owners, a turboprop or single-pilot jet is bought because it means a reliable way to travel far and fast while being able to deal with all but the most severe weather.

DEFINE THE MISSION

With that as a starting point, the next question becomes defining the mission. Will you be by yourself or with one or two others on business, or carrying a crowd for business or pleasure? Can you park your ego at the door before your make the buying decision? We've seen guys who feel they have to taxi to the ramp in a jet but have a turboprop budget. They buy a 40-year-old jet because they can afford the price of admission and then discover that the cost of upkeep is why the purchase price was so low and they can't afford to fly it.

A good aircraft manager knows the turbine world intimately and will sit down with you early on to help you fit your budget and mission to the right airplanes.

That means finding a manager before you buy the airplane because you will probably save more than the manager's fee in the purchase of the airplane.

The manager should be intimately familiar with the type of airplanes you're considering. You're paying for expertise, not a learning curve. The good news is that there are a lot of people who know King Airs or the Cessna Citation line well, so unless you have your heart set on a Piaggio Avanti you will probably have a number of potential managers to interview. Plus, most of the manufacturers offer management services.

SELECTING A MANAGER

We got inconsistent feedback on the need for a local manager; however, after talking with a number of owners and managers, for an owner-flown airplane, it's not bad to have someone who is on the airport and is willing to get her or his hands dirty helping with some of the day-to-day stuff.

We spoke with one owner who did not want to be identified. He hired a pilot to fly his CJ-4 with him as well as to manage the airplane. For $2000 a month above the salary for the pilot, the pilot provides turnkey management for the airplane, down to cleaning out the trash after a flight.

We talked with managers who work from a distance and found that meant that so long as the local FBO could do at least basic turbine maintenance they could handle whatever level of management the owner wanted, including contracting to clean the hangar.

We suggest interviewing at least three prospects to see if there is a fit and to see if you can agree on management terms. Professional managers should be able to give you a draft agreement immediately. Unwillingness to do so is a red flag, as is any agreement in which you pay an extra fee, such as a percentage, for maintenance performed.

You will be getting advice from your manager and should be paying a flat-rate fee for the service. Remember and follow one of the oldest axioms of aviation: Don't take

PISTON AIRCRAFT MANAGEMENT: OPTIONS INCREASING

Until a decade ago, there wasn't much management available for piston aircraft owners—such "management" as existed largely consisted of relying on the local shop to give you a nudge when it was oil change or annual time.

That started to change in 2008 with the appearance of Savvy Aircraft Maintenance Management (SAMM) (www.savvyaviation.com) and has evolved to where there are now a few management companies in some large metropolitan areas offering what amounts to concierge service for you and your piston airplane. We took a look at what SAMM currently offers as well as one of the largest full-service management services.

In the 12 years since it began, the maintenance management program offered by SAMM has proven popular. According to founder Mike Busch, SAMM currently has over 4000 clients for its full-service maintenance management program (there are varying levels of service offered). Full disclosure: A few years ago, when I had an ownership interest in a Cessna T210, it was one of SAMM's managed airplanes. SAMM managed an engine overhaul for the airplane when it broke down over 1000 miles from home. That included working with the shop where the airplane was to remove and replace the engine, helping the owners select an overhaul shop, shipping the engine and keeping on top of progress during the overhaul.

We like that the SAMM programs are flat-fee arrangements—there are no hidden fees or add-ons. The rate is $750 per year for piston singles and $1000 for twins. (The website gives full details on costs and terms—SAMM is one of the most transparent companies we've run across in aviation.) SAMM asserts, and owners tell us, that it's common for Savvy to save at least the cost of the annual fee in maintenance for the owner.

The system works via email with the owner's personal "account manager" (who is always an A&P/IA with significant experience) acting as a single point of contact for the owner to arrange for all maintenance. The shop inspects the airplane and gives the account manager a diagnosis and an estimate for the repairs via email. No work is done until the owner and account manager have conferred. Only when the owner approves is maintenance performed. That way, there are no surprises in the final bill.

SAMM's service includes breakdown assistance (it is also a standalone service and a number of aircraft insurance companies are including it in their policies as a benefit of buying the policy). Should you break down away from home you call SAMM on a line that has a human to talk with 24/7 as well as an A&P/IA on duty 24 hours a day. Within 15 minutes you'll be speaking with a SAMM A&P who has a database of good (and bad) shops across the country and the process of getting you on your way will be underway.

SAMM offers assistance in aircraft purchase—reviewing logbooks, setting up and monitoring prebuy examinations and helping to close the deal. It will also manage overhauls and upgrades.

SAMM also offers a sophisticated analysis service for engine monitor data (some of which is free). With 2.5 million flights in SAMM's engine monitor database, it is increasingly capable of predicting engine problems based on reviews of downloads from customers' engine analyzers—and reaches out to its clients when it sees evidence of impending problems.

There's not room in this sidebar to go through all of SAMM's myriad services. We recommend that owners of piston twins and high-performance piston singles explore the website; it may result in significant savings.

What is probably the largest example of full turnkey, concierge piston aircraft management is Performance Flight (www.performanceflight.com) of White Plains, New York. Targeted at the Cirrus line, and encouraged by Cirrus Aircraft, a $700 monthly fee means the owner is able to drive to the airport and the airplane is waiting, ready to go. We were told by Performance Flight's founder Lewis Liebert that the management team will do everything from helping a prospective owner select the right airplane and buy it through operating it, including assuring that onboard databases are updated and the airplane undergoes all needed maintenance.

Liebert's company also uses its leverage as a full-service Cirrus partner to obtain discounts on insurance (all of the aircraft have $2 million "smooth" coverage) and a local fuel discount of some $2 a gallon.

Performance's management team evaluates engine monitor downloads and briefs owners on results as well as making gentle suggestions regarding engine operating techniques.

Similar service is offered at Cirrus partners Nassau Flyers on Long Island's Republic Airport and Mike Goulian Aviation on the Bedford and Plymouth, Massachusetts, airports. We'll be watching to see if the service expands to other areas of the country.

Sign-off paperwork (and money) keeps an old Falcon in the air. The FAA agrees, and a good aircraft manager can handle the record keeping that tags along with complex and frequent maintenance events.

advice from someone who is trying to sell you something.

The manager should have the resources to get you moving again if the airplane breaks away from home—get repairs started rapidly and, if needed, arrange for alternative transportation.

If the manager is more than a one-person shop (we have no objections to small operators, they can be some of the best), longevity of the staff and experience in the industry is important.

A manager should be willing to undergo periodic audits to ensure they are following "best aviation practices" for safety, especially if the management involves providing pilots. Two of the best known auditing companies are Argus International (www.argus.aero) and Wyvern (www.wyvernltd.com).

WHAT CAN YOU EXPECT?

In our opinion, a manager should not only make your life as a turbine aircraft owner easier, the manager should save you money.

The services start with helping you select the right airplane and then, working with you, your lawyer and accountant, being the single point of contact to arrange for the prebuy, evaluate its results, negotiate the purchase agreement and arrange delivery of the airplane.

We were told of managers who drove their own vehicles a few thousand miles to get the "stuff" (manuals, spares, specialized tools) that went with an airplane but wouldn't fit in it on the delivery flight.

A good manager will be involved with making sure the airplane is properly insured, that you and anyone else who flies it get the required training and that you don't inadvertently fly it in violation of the FARs or insurance. She or he cuts fuel price and training deals (bigger management companies may be better for this), tracks all required maintenance, gets the maintenance performed, negotiates prices on parts and makes sure that the small things that are needed to make the airplane go are available. That includes everything from making sure your electronic flight bag is up to date to having tissues in the cabin.

PRICE?

Start at $2000 per month and move up depending on the service you want. We didn't speak with anyone who thought that a good aircraft manager wasn't worth the cost. However, we did speak with some who said that it took a little looking to find the right one. They advised patience, persistence and making clear exactly what is expected of a manager because the heart of the relationship boils down to good communications between the owner and manager.

PART 135?

We looked at the pros and cons of leasing a piston airplane to a Part 135 operator in the December 2017 issue of *Aviation Consumer.* Our bottom line was that we didn't think it was a good idea as it rarely pans out financially and your airplane gets beat up as if it's a used car. Our research for this article led us to the same conclusion for turbines.

To start with, you pay a great deal of money just for the inspections necessary to get the airplane onto a 135 certificate before a cent of revenue comes in. You then pay the 135 operator for maintenance, which makes the operator money, so there is a clear conflict of interest if the operator also manages your airplane.

And, according to aircraft broker Kasey Lindsay, your airplane "depreciates at the same rate you get paid—there's no profit in it." He, and others, told us that the only one who makes money on Part 135 lease deals is the Part 135 operator. While he may be excessively cynical, that's consistent with our observations over the years.

CONCLUSION

In our opinion, the complexities of required maintenance on turbine airplanes, getting it performed and making sure that the owner and airplane are legal and meet insurance requirements mean that one of the smartest decisions a turbine aircraft owner can make is to hire an aircraft manager.

JURASSIC JETS: TRAINING AND INSURANCE COSTS UP

We're not crazy about the fact that something we predicted in these pages over the last two years has come to pass. The reality—significantly higher insurance rates—is hitting pilots right in the wallet. The new, "hard" insurance market is especially challenging for those owners who bought an older jet for a bargain-basement price and thought they got a great deal.

We watched—and enjoyed—the soft aviation insurance market for more than 10 years. There were so many companies offering aviation insurance that none of them was making money and several were dealing with red ink year after year as they cut prices to compete for business. We didn't think the situation was sustainable and predicted back in 2018 that premiums would increase significantly.

After talks with insurance brokers and jet owners, we came to the conclusion that the hard market is here and those most affected are the owner-flown jet crowd.

We'll start with training because beyond the FAA requirement for a type rating to fly a jet, all training is driven by insurance requirements. Those requirements have gotten much stiffer.

In our interviews with insurance brokers, we presented a situation of a pilot who buys an older Citation, Learjet or Falcon where the engines are probably worth more than the airframe. The owner got a good price on the jet and plans to run it until the engines are worn out and then junk it. If the jet is certificated for single-pilot operation, the owner wants to fly it single-pilot. He or she is looking for insurance coverage.

Until this year, unless the owner had a history of wrecking airplanes, he or she was almost certain to be able to get coverage and companies would compete to present the most attractive price, coverage limits and training required package. The premium would depend on the pilot's experience and age—even in the soft market jet pilots who had hit 70 faced some challenges in obtaining coverage. The insurance companies were also offering fairly high liability limits for owner-flown jets—often over $10 million.

The training required would depend on the pilot's experience, but it was common for the insurer to allow the owner to take initial and recurrent training through an approved operation that did the training in the owner's airplane rather than in a simulator. In some cases, we saw recurrent training requirements that were as lax as once every 24 months rather than annually. It was pretty common for owners who had two types of turbine flying machines to be able to alternate years for recurrent training in each.

Those are now the good old days. We heard from multiple sources that insurance companies don't like old jets and that now the new hard market has allowed them to act on their preferences. Insurers are increasingly refusing to cover owner-flown, older jets or do so only for much higher premiums and under more strict training conditions, with lower coverage limits. Mike Pratt of Fifth/Third Insurance told us that he is seeing rate increases for owner-flown jets of 5 to 30 percent in the last year. He also said that every-other-year training is a thing of the past. If the owner has a King Air and a Citation, that owner is going to have to take recurrent training for each, every year.

Pratt also said that unless the pilot has considerable experience in type, the insurer is going to require that recurrent training be simulator based, not in the airplane—running up the cost. Insurers are also requiring that all initial type rating training be simulator based, not in-airplane. That means going to the heavy hitters in the training world such as FlightSafety and SimCom. Plan on at least $30,000 for a type rating. We could not get hard numbers for recurrent training as the operators offer a large number of contract arrangements based on a number of variables. Nevertheless, we think that a jet owner should plan on at least $10,000 annually for recurrent training.

Ed Underwood of AVsurance confirmed what we'd been hearing about a hardening aviation insurance market. He said that in the situation where pilots have purchased older jets with a value dependent on the value of the engines that the insurer may require such things as deductibles for FOD coverage or on the hull itself, something unheard of in the soft market. Previously, the insurer would pay for hull damage or repairs due to FOD from the first dollar. Now the owner will have to have some skin in the game. In addition, should the jet have to have engine work performed and the shop installs a loaner engine, the chances are that the insurer is going to raise the premium because the engine may be more valuable than the entire airplane.

Underwood also told us that it is becoming increasingly difficult to get coverage for single-pilot operators unless the pilot has significant experience. Insurers are leery of "Silicon Valley" types with 500 hours buying a jet and seeking insurance. Assuming the pilot can pass the type rating ride, he or she can count on the insurer requiring that a mentor pilot ride along for some time.

Bottom line: Buying a cheap jet may be one of the most expensive things you do when it comes time to buy insurance and arrange for training.

AD On Cessna 210 Fleet, ITDM Pilots Get a Chance

Wing spar corrosion is the concern for most of the Cessna Centurion fleet. Meanwhile, the FAA updates the protocol for diabetic pilots.

by Larry Anglisano

After a Cessna T210M experienced an inflight breakup in Australia last year, the FAA has issued AD 2020-03-16, effective March 9, 2020, for the visual and eddy current inspections of the carry-through spar lower cap. The AD isn't isolated to M-model Centurion, but also applies to the 210G, T210G, 210H, T210H, 210J, T210J, 210K, T210K, 210L and T210L series.

According to the AD, corrective action includes replacement of the carry-through spar (if necessary), application of a protective coating and corrosion-inhibiting compound and also reporting the inspection results to the FAA. In the accident airplane, it was fatigue cracking that initiated at a corrosion pit (severe corrosion was also reported on other Centurions) that ultimately caused the wing failure.

Expect some teardown just to accomplish the initial inspection. This requires removal of the headliner, the oxygen plumbing and head protection foam pads from the spars and anything else in the way of an unobscured inspection of the full strut.

The issue shouldn't be a surprise for 210 owners. The FAA issued an airworthiness concern sheet (ACS) on June 27, 2019, advising owners and operators of the accident and requesting relevant information about the fleet. Following the ACS, the FAA received reports of widespread and severe corrosion of the carry-through spar—something that should be a concern for anyone shopping the 210 market.

Moreover, investigation identified that these early-model airplanes were manufactured without corrosion protection or primer, increasing their susceptibility to corrosion. In the discussion portion of the AD, the FAA says the design of these early-model airplanes, where the upper surface of the spar is exposed to the environment, allows a pathway for moisture intrusion. Model 210-series airplanes were also delivered with foam installed along the carry-thru spar lower cap. The foam traps moisture against the lower surface of the carry-through spar cap, which can increase the development of corrosion, says the FAA.

For more compliance data, see Textron Aviation Mandatory Single Engine Service Letter SEL–57–08, Revision 1, dated Nov. 19, 2019 (SEL–57–08 R1). This service information contains instructions for visually inspecting the carry-thru spar for corrosion, damage and cracks and for completing an eddy current inspection. This service information also specifies applying protective coating and corrosion inhibiting compound.

We covered the Cessna 210 series in the February 2017 *Aviation Consumer* Used Aircraft Guide.

GOT INSULIN?

If you do and need it to control your diabetes and want FAA medical certification higher than Class 3 criteria, there's good news. The FAA published a notice in the Federal Register on risk assessment for the Diabetes Protocol given the progress that's been made in treating and monitoring the disease.

Essentially it says that ATP and commercial pilots with insulin-treated diabetes mellitus (ITDM) might receive first- and second-class special-issuance medical certification for ATP and commercial flying privileges.

Worth mentioning is that since 1996 the FAA has allowed special-issuance medical certification for private pilots seeking third-class medical certification, but that just wasn't good enough for ATP or commercial flying duties.

If you're a diabetic on insulin and even if you only want a third-class medical, you can still apply under the old FAA protocol or this new one. For more, contact Marcia Alexander-Adams at marcia.adams@faa.gov.

The Cessna 210 Centurion (that's a 1982 T210N pictured at the left) has a strong one-piece wing. The one that broke up in Australia was performing low-altitude aerial surveying and had severe corrosion.

COCKPIT GADGETS

Screen Reflector HUD: Limited By App

For $19.95, the Hyperion smartphone heads up display succeeds in getting phone data at eye level, but we wish it worked with more apps.

by Larry Anglisano

In a market dominated by big-screen primary flight displays it's easy to see why high-priced HUD technology hasn't gained traction in large numbers for small airplanes. But smartphones have grown larger screens that may be useful for displaying nav data and don't take much space in the cabin.

And that's why Sporty's has been marketing the Hyperion smartphone reflector product, which puts the phone data at eyeball level on the glareshield by reflecting on a screen that mimics that of a HUD. It's dirt cheap at only $19.95, but one problem is it doesn't work with the most popular aviation apps.

AUTOMOTIVE INSPIRED

The Hyperion by Dellran smartphone navigation heads up display is really focused on ground navigation in vehicles, but the concept can work in anything—including aircraft. The unit is sold to work with the Hudway Go app, but for use in the aircraft it works with the Appareo Stratus Horizon Pro app.

The device needs no power; it simply reflects what is on the screen of an iPhone or Android device onto a 6.5-inch angle-adjustable mirrored screen. The idea is to reflect backup attitude data onto the screen, turning any smartphone into a HUD-like screen that's positioned on the glareshield in an area that's more convenient than, say, your lap. The viewer is partially transparent and the 45-degree angle adjustment seemed to be right for a decent HUD-like image. The specs says the viewer produces a 20 percent larger image than the phone's display.

Out of the box the device, which has a 6 by 3.75 inch flat base, is easy to set up. All you do is stick the supplied transparent reflection film to the front side of the organic glass board. The base/smartphone holder doesn't hard attach to the glareshield, but instead sits on a non-slip mat, to keep it from moving around. And it's sticky enough to hold it in place, but the smartphone just rests (face up, of course) on the base so the screen can reflect on the viewer.

I tried the device with an Apple iPhone XR in an Otterbox Defender screenless case and it fit nearly perfectly. The trouble, though, is that any sizable amount of turbulence can shift the phone partly off the base. In a crash the last thing to go through your head might be the phone.

WHICH APPS?

As we go to press the only aviation nav app that's compatible is the Appareo Stratus Horizon Pro, from the company that makes the Stratus ADS-B products, of course. What's unique about this app is that it has a Mirror Display mode for reverse imaging. The app requires a Wi-Fi-enabled Stratus ADS-B receiver for the AHRS display. No, ForeFlight and Garmin Pilot won't work, and John Zimmerman at Sporty's (which has passed on selling high-end HUDs) called it straight.

"We're hoping this dead-simple and affordable product inspires other app developers to add a HUD/Mirror mode to their apps," he told us. Visit www.sportys.com.

The phone reflector HUD on the bench and in the airplane. We think it's sized just right, but wish the base provided better anchoring of the smartphone in turbulence.

Piper Archer/180:

Predictable, stable and familiar, a used PA28-180/181 makes for a utilitarian ownership experience.

CHECKLIST

An Archer has predictable and solid handling, making it a good IFR platform.

Both factory and field support is excellent. Who doesn't know how to work on one?

~ Don't expect to get there fast. 125 knots is about all you'll get.

If you're shopping for a used low-wing four-place cruiser, the starting point might be the Cirrus SR20 or Diamond DA40. If they break the budget, there's always a Piper Archer. And for the right one, that's not a bad compromise.

The current market has a wide variety of venerable Piper PA28-180/181 models for sale, typically priced from $28,000 for an early 1960s 180B to nearly $385,000 for a late-model Archer DX.

Don't worry about field support. Piper seems to have it covered, plus what experienced mechanic can't work on a Cherokee and its Lycoming O-360? Here's a look at the current market and what to consider when adding one to the hangar.

HISTORY

The PA-28-180/181 series, of course, can trace its roots back to the basic Cherokee 140 and point to close relatives like the Arrow, Cherokee Six/Lance/Saratoga and even the Seminole twin. All owe their existence to the first Cherokee airframe originally designed by the late John Thorp, best known for the crank-winged Thorp T-18 homebuilt, among his many other designs. He reportedly considered the PA-28 among his favorites and, if viewing an original copy in plan form, one can easily see the resemblance between the first Cherokee and the Thorp T-18.

And this Piper's lineage highlights something Piper has always done well, perhaps better than everyone else: Build a good basic model and evolve it into improved follow-on products without greatly increasing manufacturing costs. First rolled out in 1963, the original Cherokee 180 has been upgraded considerably, but is fundamentally still the same airframe, with some 10,000 flying.

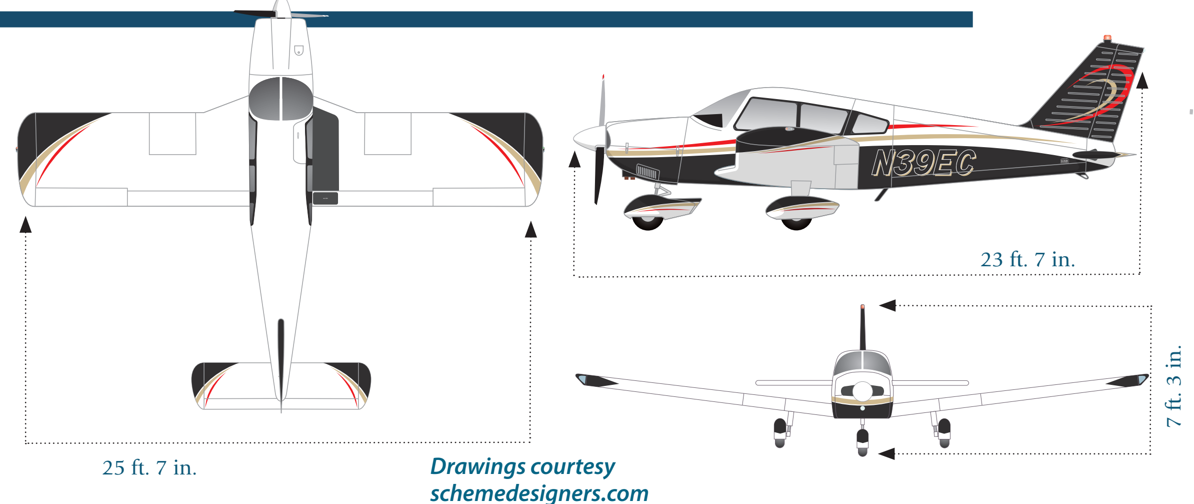
The first Cherokee 180 had the constant-chord Hershey-bar wing (span 30 feet)—so named because of its resemblance to the candy bar—and a Lycoming O-360-A3A engine. That early engine had a TBO of only 1200 hours, mainly due to a weak valve-train design, including 7/16-inch exhaust valves, which was far from Lycoming's best effort. Later, those engines were switched to ½-inch valves, which increased the TBO in part by eliminating chronic issues with excessive wear and heat-induced damage. The smaller valves long ago should have been flushed entirely from the market by overhaul or remanufacture, but prudent buyers will check anyway if looking at an older engine.

The Piper Cherokee didn't get to be an industry-standard airplane by having handling quirks; it simply has none.

The newer engines all carry Lycoming's more-or-less standard 2000-hour TBO, and the overall engine has a well-earned reputation as one of the company's—if not the industry's—more bulletproof designs. In fact, the engine's reputation is one of the reasons for the Ar-

That's a 1968 PA28-180D in the lead photo sporting a modern paint scheme created by Scheme Designers.

PIPER PA28-180/181 ARCHER

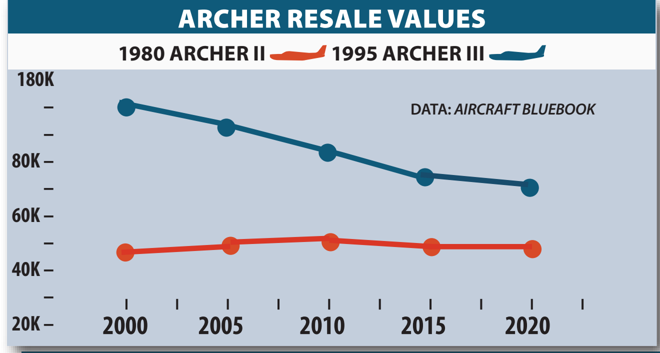


Drawings courtesy schemedesigners.com

PIPER CHEROKEE 180/ARCHER SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1963-64 PA-28-180B	LYC. 180-HP O360-A3A	2000	$21,000	50	1170 LBS	124 KTS	±$28,500
1965-67 PA-28-180C	LYC. 180-HP O360-A3A	2000	$21,000	50	1170 LBS	124 KTS	±$31,000
1968-69 PA-28-180D	LYC. 180-HP O360-A3A	2000	$21,000	50	1090 LBS	124 KTS	±$35,000
1970 PA-28-180E	LYC. 180-HP O360-A3A	2000	$21,000	50	1090 LBS	124 KTS	±$38,000
1971-72 PA-28-180F	LYC. 180-HP O360-A3A	2000	$21,000	50	1090 LBS	124 KTS	±$42,000
1973 PA-28-180 CHALLENGER	LYC. 180-HP O360-A4A	2000	$21,000	50	1055 LBS	123 KTS	±$44,000
1974-75 PA-28-180 ARCHER	LYC. 180-HP O360-A4A	2000	$21,000	50	1055 LBS	123 KTS	±$45,000
1976-1994 PA-28-181 ARCHER II	LYC. 180-HP O360-A4M	2000	$21,000	48	1134 LBS	125 KTS	±$67,000
1995-2000 PA-28-181 ARCHER III	LYC. 180-HP O360-A4M	2000	$21,000	48	1134 LBS	125 KTS	±$95,000
2001-2005 PA-28-181 ARCHER III	LYC. 180-HP O360-A4M	2000	$21,000	48	870 LBS	125 KTS	±$130,000
2006-2010 PA-28-181 ARCHER III	LYC. 180-HP O360-A4M	2000	$21,000	48	870 LBS	125 KTS	±$195,000
2011-2014 PA-28-181 ARCHER LX	LYC. 180-HP O360-A4M	2000	$21,000	48	870 LBS	125 KTS	±$310,000
2015-2018 PA-28-181 ARCHER LX	LYC. 180-HP O360-A4M	2000	$21,000	48	870 LBS	125 KTS	±350,000

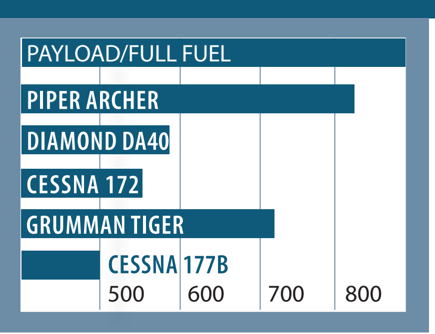
ARCHER RESALE VALUES

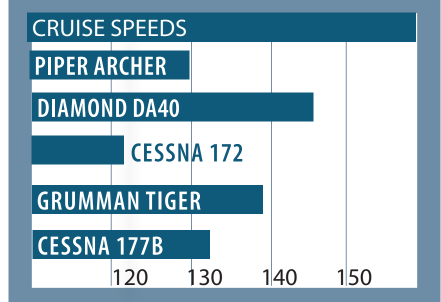


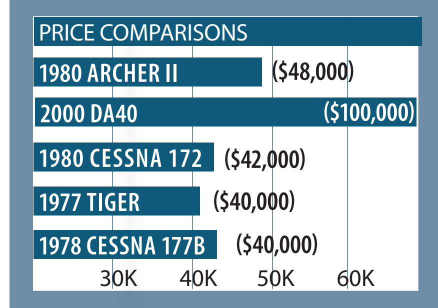
SELECT RECENT ADs

AD 04-14-12	CONTROL WHEEL HARDWARE
AD 99-05-09	INDUCTION AIR FILTER
AD 96-10-03	FLAP HANDLE ATTACH BOLT
AD 95-26-13	OIL COOLER HOSES
AD 86-17-01	AMMETER REPLACEMENT

SELECT MODEL COMPARISONS







Archers and 180s have a wide variety of avionics, from round gauges to OEM glass. That's an older 180 with a Garmin GNS 430 and Royalite plastic overlays at the top and a newer Archer in the bottom photo with a flat panel and Garmin G1000.

cher's ongoing popularity. Throughout its history, the PA-28-180/181 has used essentially the same Lycoming O-360—still 180 HP—with only minor variant changes, although many wish for fuel injection.

After five years of production and few airframe changes, the instrument panel was modernized and a third, trapezoidal window was added to each fuselage side in 1968. This resulted in the airplane's current ramp presence while admitting more light into the cabin. A longer wing came along in 1973—still with a constant chord, though—accompanied by a bigger stabilator and a five-inch fuselage stretch. The extra inches made a noticeable difference on cabin space.

At the same time, a modest, 50-pound boost in gross weight (to 2450 pounds) improved the airplane's payload by half a person while a larger door, more-crash-worthy seats and additional panel improvements rounded out the cosmetic improvements.

For 1973, the Cherokee 180 became the Challenger, but that wasn't a Native American name, so Piper quickly changed it again—to Archer, beginning with the 1974 model year—continuing its ongoing theme. (Neither of those strictly are Native American names either, but despite the illogic, Piper's are perhaps easier to follow than Mooney's.)

It wasn't until 1976 that the new tapered wing—still the standard configuration today—was introduced to the 180-HP airframe, resulting in the type-designation change to PA-28-181, which also continues with the current model. This change was so significant the model received yet another name: Archer II. Subsequent-manufacture PA-28-181s are known as Archer IIIs, while the latest Archer is the LX.

The basic tapered wing first was installed on the then-new 1974-era Warrior and, after a few tweaks involving the aileron control system, was added to the company's other PA-28 models and, eventually, to the PA-32. The new wing's inner panels were still constant-chord, while the outer panels were both lengthened and tapered. Wing-mounted fuel tanks remained in the same location, although total unusable fuel increased by two gallons.

The Archer II got a powerplant change as well, to the -A4M version of the 180-HP Lycoming O-360. That same engine is installed in new Archers today. These changes, of course, brought escalating prices. An original, 1974 PA-28-180 Archer with average equipment brought in $23,495 to Piper's coffers while a typically equipped 1980 Archer II sold for $47,610.

There was no 1991 Archer, as Piper became ensnared in the light-aircraft industry's overall economic troubles, but by 1995 a reinvigorated and rebranded company—New Piper—rolled out the Archer III. It sold for $181,700, again with average equipment installed. We'll always remember plucking one of the first Archer IIIs from the Vero Beach factory ramp during a ferry mission, while marveling at its modern appointments, compared to the early ones we grew up with.

By then, the New Piper Archer III got an upgraded cowl, an all-metal instrument panel, factory-installed

Garmin GNS 430/530 navigators, new paint schemes, air conditioning, better seats and an improved exhaust system. A 2010 model retailed for $299,500, and came standard with an Avidyne Entegra glass panel, an S-TEC 55X autopilot, air conditioning and two Garmin 430W navigators.

Priced in the low $400,000 range, the current Archer LX has Garmin's G1000 integrated avionics (standard are two 10-inch displays), electronic engine indication system, a backup EFIS system, plus an ultra-modern paint scheme. It still has Lycoming's O-360-A4M engine mated to a Sensenich two-blade propeller.

Speaking of engines, in 2014 Piper unveiled the Archer DX at the Aero show in Friedrichshafen, Germany. It has Continental's 1200-hour TBO and FADEC-controlled CD-155 diesel.

LOADING AND PERFORMANCE

For 180-HP airplanes, Archers haul respectable loads. Empty weights vary by year and example, of course, but one owner told us his PA-28-180's empty weight was 1452 pounds on a gross weight of 2400 pounds. With full tanks, that allows 650 pounds of people and stuff, or three husky people and a bit of baggage. Not bad.

Later Archers allow a 2550-pound gross but empty weights are often higher, so payloads are lower. A 2010 Archer III with standard equipment weighs in at a hefty 1688 pounds empty with a ramp weight of 2558 pounds, for a useful load of 870 pounds. Older Archers might beat that by 75 pounds or more. With four people in the airplane and, say, 50 pounds of baggage, a typical example has room for 35 to 40 gallons of gas, or about three hours' endurance with 45-minute reserves. Again, not bad for a modest airplane. If the passengers are light, full fuel and full seats may be possible.

Performance-wise, the Archer is respectable, but no one will mistake its numbers for a Bonanza's, or even an Arrow's. How fast you go on 180 HP depends on the year of manufacture and the equipment. Specifically, the semi-tapered wing on the 1976 and later Archers yielded benefits at both ends of the airspeed spectrum. The stall dropped by 4 knots and cruise speed went up by about the same amount. The large wheelpants available in 1978 add another 4 knots or so to cruise speed.

An Archer's cabin, top, isn't exactly cavernous, but it works for average-sized adults. Pull the cowling and mechanics have full access to the familiar Lycoming O-360 powerplant, bottom.

Even so, a late-model Archer with wheelpants will cruise at only about 120 knots, although some owners insist they see 125 to 130 knots. (We suspect erroneous airspeed indicators or tachometers.) The airplane gives up 10 knots to a Tiger but pulls ahead of a Cessna 172. Climb rate, while better than a 172, isn't stellar. According to the POH, the airplane will climb out from sea level at about 740 FPM but, by the time it reaches 6000 feet MSL, upward mobility has trended off to around 450 FPM. As many owners attest, original Archers with the Hershey-bar wings eke out slightly better rate-of-climb numbers than later models with tapered wings.

The nosewheels are steerable on the ground, and the rudder pedals come with conventional toe brakes. Parking or emergency braking is controlled by a meaty handle and locking mechanism just to the left of the center console and easily manipulated with the pilot's right hand.

Unless the airplane is air-conditioned, summertime cooling of the occupants can be a problem on the ground and at low altitude. Fresh-air ventilation is via wing-root inlets with outlets above the floorboards, supplemented by fan-driven overhead vents getting fresh air from an inlet at the top of the vertical stabilizer. Neither works well on the ground, requiring an open-door policy until right before takeoff. The good news is the Archer's heating system usually works well.

Piper long ago abandoned its overhead pitch trim control—pilots never could remember which way to turn it to get what they wanted—and put a conventional wheel on the center console, between the seats. Below the instrument panel,

Wayne Michelli sent the photo of Challenger N4373T flying today and in Piper's sales brochure from 1973—the year of the "big" Cherokees. The Challenger was dropped in 1974 and it became the PA28-181 Archer.

in a center pedestal, is a rudder trim knob, though it's not always necessary.

Early airplanes came with a double stack of avionics, with less-critical boxes mounted in a second column to the right of center. Again, many of these airplanes have since seen an avionics shop for upgrades, but many others haven't. Reaching to the far side of the panel isn't a chore, but it's an inconvenience and something you should consider for a potential purchase. Recent upgrades may have eliminated boxes from the right stack, but unless the entire panel was redone, cosmetics may suffer.

Wing flaps are controlled with a Johnson-bar handle between the seats, including detents. It's an easy system to deploy smoothly, while also affording the ability to immediately retract or extend flaps, depending on your needs, without having to wait for an electric motor. And, of course, they're fully available even in the event of an electrical failure. Deploying flaps does result in an upward pitching moment, but it's relatively easy to counteract with forward pressure on the yoke. Most crosswinds are easy to handle, thanks to the low wing and wide gear.

Early airplanes mounted the circuit breakers to the far right of the instrument panel, about as far from the pilot as possible. Same with the heat/defrost controls. On the upside, frequently needed switches—master, fuel pump, beacons and the like—are mounted just above the engine controls. System gauges are just below the flight instruments, with an idiot-light annunciator panel above them. The tachometer is mounted in front of the pilot's right knee, which often makes for unnecessary head motion during takeoff.

COMFORT AND HANDLING

Occupants should have no trouble remaining comfortable during a three-hour leg, although pre-1973 back seats—before the five-inch fuselage stretch—are somewhat tight. Pipers have decent but not exceptional front seats with an S-shaped frame designed to absorb energy in a crash. The height adjustment uses a gas-assisted spring and when this wears out, the seat automatically falls to its lowest setting, giving a short pilot a good view of the glareshield, but little else.

The seat stuffing tends to compress with use, causing sags, and the plastic back trays on the seats aren't at all durable and fall apart with use. The aftermarket is your friend, as relatively inexpensive solutions exist for both well-known issues. There's an adequate baggage compartment behind the rear seats that's accessible in flight, but can't be opened from the inside.

Cabin appointments can range from the original avocado green or bright orange upholstery and sub-panels dating from the 1970s to more tasteful and less jarring designs, including what seems to be the new industry standard: light gray fabric or leather. Later models came with all-metal instrument panels—the Royalite plastic overlays were finally banned.

The Piper Cherokee didn't get to be an industry-standard airplane by having handling quirks; it simply has none. Its flight controls are relatively well balanced, with roughly equivalent pressures required in all three axes. The Archers are safe, stable and predictable and easy to land, even on short runways. In slow flight, the airplane has no bad habits, nor does it build speed in unusual attitudes.

Despite the tapered wing's better looks and—as many pilots confirm—its improved roll response, the market hasn't always treated the Archer II well. In fact, there's not much difference in performance between the Hershey-bar-winged versions and the tapered wing. The original Archer wing's span of 32 feet increases to 35 feet, five inches on the Archer II after it's tapered, while the service

The Archer DX has a 155-HP Continental Centurion CD-155 Jet-A-burning engine that's single-lever FADEC controlled and has a three-blade MT wood/composite propeller.

ceiling decreases and takeoff ground roll increases. Distance to clear a 50-foot obstacle is markedly reduced by tapering the wing, however, as is stall speed.

Those numbers—and perhaps the ability to use a smaller hangar—probably explain why clean, early Archers—the 1974 and 1975 models—today sell in the $50,000 range, according to 2019 trends, while their slightly younger brethren fetch less, on average. The deficit isn't overcome until the 1980 model but—all things being equal—prices start escalating from there. By comparison, a 1980 Cessna 172 retails for about $45,000 while a Grumman/GA Tiger of about the same vintage sells for around $50,000. You can't touch a newer Archer III for under $100,000, in general. Want a DX with the Continental CD-155 diesel? They're out there starting in the mid-$300,000 range, and the 1200-hour TBO engine has a typical overhaul price of $50,000, according to the latest *Aircraft Bluebook*.

MAINTENANCE

Archers don't have much AD baggage. It was the target of a controversial AD in 1987 calling for an expensive inspection of the wing spar for cracks. This procedure required de-mating the wings and cost some $1200 at the time. In typical FAA overreaction, it was an emergency measure brought about by the crash of a 7000-hour Archer used for pipeline patrol. That AD was rescinded when the expected rash of cracked spars failed to materialize.

However, in reviewing recent service difficulty reports, we noted that mechanics are finding evidence of corrosion in the spars, at least one of which required replacement. This corrosion is often discovered when leaking fuel tanks are removed for repair. Make sure a prebuy includes an inspection and check the wing-attach fittings, too.

Check the baggage door for a leaking seal; the telltale sign is wet or

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PA28-180/181 ACCIDENTS: RLOC

After reviewing the 100 most recent accidents involving the Piper PA28-180/181 series we found ourselves feeling sorry for the airplanes. In the pilot/airplane flight partnership, the Cherokee 180s and Archers generally held up their end of the deal—there were only eight accidents resulting from something wrong with the airplane (engine stoppage).

On the other side of the equation, pilots found many ways to wreck what we consider to be an honest line of airplanes.

Continuing to look at engine stoppages, the 180-HP Lycoming has a reputation for not being susceptible to carburetor icing. However, it's not immune—two airplanes were brought down by carb ice and pilot inaction.

We're cynical, but we were still astonished by the one other engine/mechanical accident. When investigators started looking at a forced landing following the loss of part of a propeller blade, they found that 17 years prior to the accident the prop had gone into a prop shop for work. The shop found the prop to be unairworthy and returned it.

The owner put the prop back on the airplane. Twelve years before the accident, an AD was issued requiring inspection for the condition that caused the eventual failure. The owner ignored it.

Somehow we can just hear the owner now, "Hey, that prop shop didn't know squat. I got 17 years of service out of a prop they said was unairworthy."

There were 23 runway loss of control (RLOC) events. That's slightly high for a tricycle gear machine, but not surprising as the majority involved student pilots.

We found six runway overrun accidents. The airplanes will float, especially when landing with partial flaps and extra speed.

There were only five stall-related accidents, most on high density altitude takeoffs at or near gross weight. One of those followed an intersection takeoff.

We consider 17 fuel-related accidents to be a high rate. Most involved pilots simply running the airplane out of fuel. One pilot who "wasn't comfortable with leaning procedure" unsurprisingly ran the tanks dry after cruising with the mixture full rich.

In response to a CFI setting up a practice forced landing, one student followed the checklist and changed fuel tanks. Unfortunately, he inadvertently positioned the fuel selector between detents. He got to experience a real forced landing.

While pilots like the manual flaps for the ability to rapidly extend them, there's no free lunch. The flaps can also be rapidly retracted. Mistakenly doing so put three airplanes into the ground, hard. Two came after takeoff. The third occurred after a CFI took the controls and initiated a go-around when the student had problems on landing. While still low and slow, the student retracted the flaps.

We felt for the instructor who took the controls as a student's swerves on takeoff became progressively worse. He got the airplane into the air and entered a turn to avoid obstructions beside the runway. The student then closed the throttle. Even though the CFI immediately firewalled the throttle, a wingtip hit the ground and ended the flight.

ACCIDENT SUMMARY
RLOC (23%)
FUEL RELATED (17%)
OTHER (15%)
ENGINE/MECH (11%)
HARD/OVERSHOT LDG (10%)
BLOWN GO-AROUND (6%)
STALL (5%)
MIDAIR (5%)
LOW FLYING (4%)
VFR INTO IMC (4%)

water-stained carpet on the baggage floor. By now, early Archers should have been through at least one interior refurbishment, so pulling up the floorboards in that area to inspect for corrosion is a good idea.

While you're back there, take a few extra moments to inspect the battery box just aft of the baggage compartment. Piper placed it there, presumably, to help with loading. But in a misguided effort to save weight, the company at one time equipped its airplanes with aluminum battery cables, which proved susceptible to corrosion. Given the lengthy cable run from the battery box to the engine compartment, many owners have encountered starting issues. Aftermarket kits and a Piper service bulletin are available to help replace the aluminum cables with copper, which isn't as prone to corrosion and high resistance.

Another problem is leaky fuel tanks, particularly on older airplanes. An airworthiness directive (AD 79-22-02) addresses peeling tank sealant, with which owners long ago should have complied. It's not much of a problem any more, certainly nothing like the hassle of owning a Mooney. The vents are also a source of maintenance trouble. One SDR found they had been installed incorrectly.

Otherwise, maintenance hotspots have to do with typical Lycoming issues, such as cracked cylinders, corroded cams and problems with Bendix and Slick magnetos. Also, on older airframes, the stabilator bushings may need work. Have them checked during prebuy. Another area to look at, according to the SDR database, is cracking in the skins of the forward wing walk. One SDR submitter reported six high-time airframes with this damage.

MODS

LoPresti Aviation (www.speedmods.com) has flap gap seals, wheelpants and flap hinge fairings. Met-Co-Aire (www.metcoair.com) offers replacement wingtips, tailcones and dorsal fins. LoPresti also offers its Boom-Beam landing-light enhancement, which we find worthy.

Knots 2U (www.knots2u.net, 262-763-5100) also sells a range of Cherokee mods, including gap seals, wingtips and wheelpants. The

company also offers upgraded strobe lights, engine air filters and aftermarket control wheels, among other products.

Laminar Flow Systems (www.laminarflowsystems.com, 386-253-8833) offers a wide range of gap seals, wheel fairings and other aerodynamic cleanup kits for the Cherokee. For fiberglass parts to replace broken or cracked plastic exterior fairings, of which the Cherokee has many, try Knots2U, and read the replacement plastic article in the October 2018 issue of *Aviation Consumer.*

There are two type clubs serving the Piper Archer models. The Piper Owner Society (POS, www.piperowner.org) consolidated its efforts with the Cherokee Pilots Association (CPA) several years back. The Piper Owner Society serves all Piper products and is a good source of tech and operating information. Meanwhile, the Piper Flyer Association (PFA, www.piperflyer.org) offers services similar to POS'. There's also www.piperforum.com, with plenty of good discussion about these aircraft.

MARKET OVERVIEW

Given the wide range of model years and histories of used Archers, it should be expected they will vary widely in installed equipment. Unlike Cessna—which only installed its house-brand ARC avionics in new piston singles until selling the unit in 1983—Piper put into its Cherokees either King or Narco products for quite some time.

A recent scan of the popular and respected sales website www.controller.com revealed quite a few earlier models still equipped with orphaned avionics, plus a mix of old and new. We found some models still sporting old-school gear like King KX170Bs, Narco MK12s, plus lots of new stuff including Garmin G5s, Avidyne IFD navigators and other latest retrofit products. Prices are all over the board, seemingly driven by these recent avionics upgrades—some impressively equipped with high-end autopilots, primary EFIS and big-screen engine monitors.

We think any would-be owner wanting to upgrade from a basic trainer—or even looking for an affordable entry-level airplane to use as a trainer, then as a platform with which to perform the weekend getaway—always should at least consider an Archer. It's a bit faster than a Cessna 172, it climbs better and it carries a smidge more, all without gulping fuel the way a 182 does.

The Archer/180 control surfaces are plenty effective enough for no bad habits around the runway, but runway loss of control is the top reason why these airplanes make the NTSB reports. That's the Johnson-bar manual wing-flap handle in the lower photo.

OWNER COMMENTS

I am in a 1974 Piper Archer partnership and from my experience, the Archer strikes a wonderful balance of performance, payload and efficiency. The Archer is no Mooney or Bonanza, but frankly, unless you are regularly flying 500-mile trips, you won't notice much difference. I just keep thinking that with a faster airplane, I would get to fly less!

The stabilator makes the plane easy to fly in the pitch axis, making it a good instrument trainer. Our plane has a useful load of about 940 pounds and is nicely equipped with modern avionics, including a Garmin GNS 430 navigator.

I'm surprised at how efficient the airplane is to fly. I often return from local flights having burned 6 to 7 gallons of fuel per hour. If you would have told me that this was likely in anything but a Cessna 152, I would not have believed it. Of course, I lean aggressively

The Aviation Consumer

Homebuilts

(continued from page 2)

tion from one homebuilt to another. There's no guaranteed certified level of handling, particularly when it comes to stability, stall response and overall flying experience. In other words, if you can fly one Cessna Skyhawk you can pretty much fly them all. That's not necessarily so in the homebuilt world.

Oh, tired of high insurance premiums for that Bonanza? Don't underestimate the cost of insuring a homebuilt—some bring hefty premiums—especially in the current hardened insurance market.

If you're new to the market, maybe limit your choices to models that are well-populated. Van's Aircraft, to name one kit, is so popular you'd be hard-pressed to not find at least one RV model living on most any airport.

One model that comes to my mind is the Van's RV-6 (tricycle gear) and RV-6A (conventional gear). More than 2600 of these kits have been built over the span of 30 years. You'll be able to round up a whole lot of support—both before and after the sale—for something like this rather than a model that exists in limited numbers.

Once you find the model that you think you want to own, go fly it. I've seen buyers smitten by ramp appeal, but bitten by flying characteristics that were beyond their skill level. For starters you want to know how quickly the aircraft accelerates, and what kinds of control inputs are required to keep it tracking the centerline. Be on the A game. As Marc Cook pointed out, homebuilts are often small and slick with a lot of power—that makes them fast and different. Find someone who knows how to fly it to teach you.

Like airworthiness directives that apply to certified aircraft (which will also apply to some engines and propellers on homebuilts, too), part of the prepurchase work will be researching a kit manufacturer's service bulletins. Depending on the size of the manufacturer and the existing fleet, this may be easy or difficult. Again, lobby the help of the EAA.

If you're serious about putting a used homebuilt in your hangar I encourage you to read the ongoing used homebuilt series in sister publication *Kitplanes*. It's resourceful and should set you on the right path.

—Larry Anglisano

Used Archer/180

(continued from page 31)

(including on the ground), which also keeps the plugs clean and the magnetos smooth.

This plane is perfect for just poking holes in the sky in an inexpensive way.

Hish Abouelleil
via email

I've actually owned two Piper Archers before upgrading to a Piper Seneca II twin, and the Seneca was mostly an easy and familiar step-up. When I look at my operating costs I sure miss the Archers. They were cheap, by comparison, in every way.

My last one was a 2005 Archer III that I purchased new and it was far more modern, at least from an ergonomics standpoint, than my earlier one. It had decent high-back seats, a flat metal instrument panel and overhead rocker switch panel. I kind of felt the fit and finish could have been a little better, though, especially the interior components. Some of the plastic began to crack.

But what I really wanted was fuel injection. It always baffled me that Piper didn't send late-model Archers out the door with the fuel-injected IO-360. To me the airplane was just a dressed-up version of the plane that came off the line in 1963.

Joe Griffin
via email

NAVION

It's time to take a fresh look at the North American Navion market for the *Aviation Consumer* Used Aircraft Guide. We want to know what it's like to own these descendants of the P51 Mustang, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your Navion to appear in the magazine, send us any photographs (full-size, **high-resolution**) you'd like to share to the email below. We welcome information on mods, support organizations or any other comments. Send correspondence on the Navion by June 10, 2020, to:

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