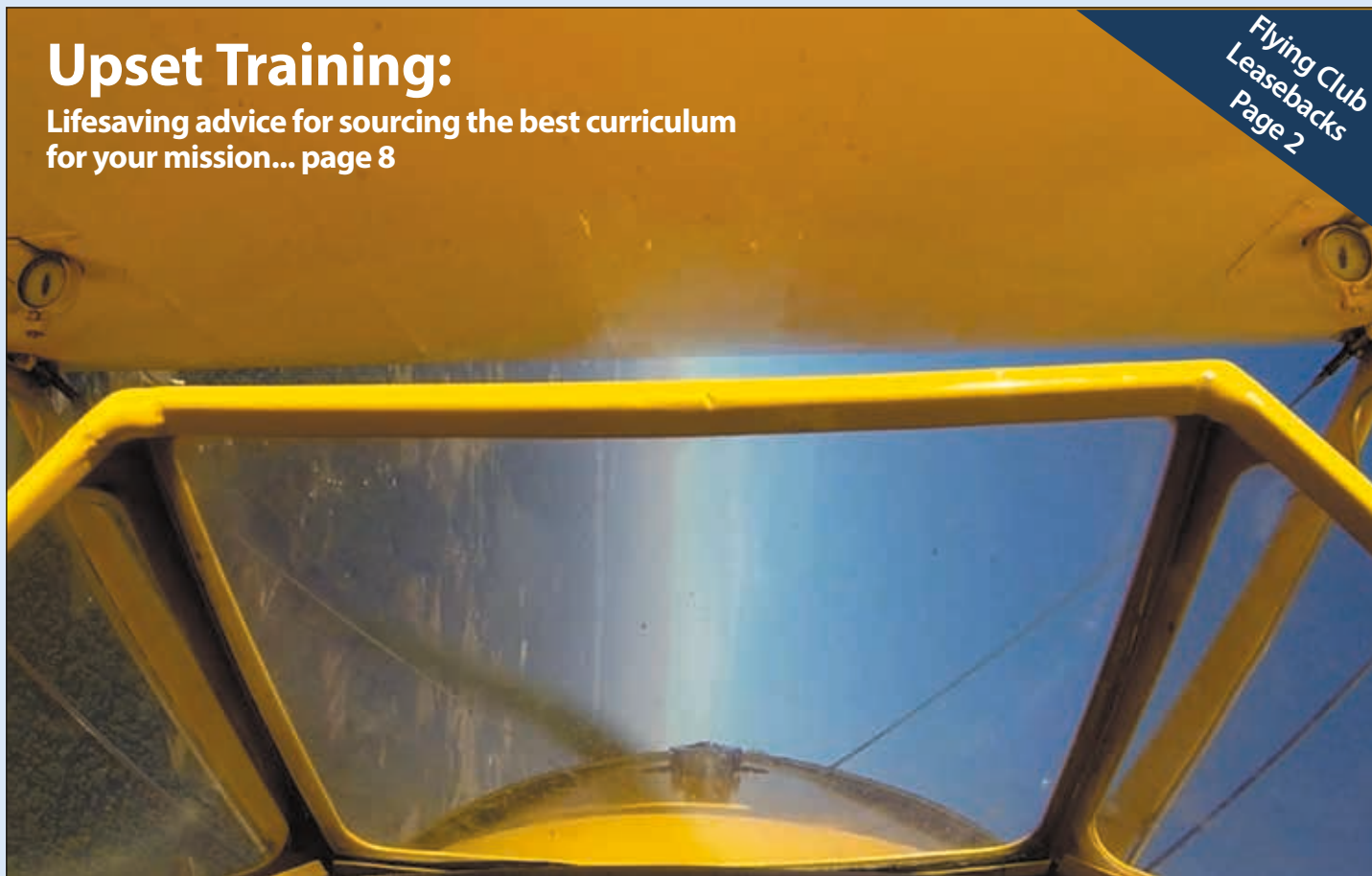


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FIRST WORD**FLYING CLUB LEASEBACK: MAGICAL TRIANGLE**

I have to think there would be more flying activity if non-owners had access to nicer aircraft. A friend who tried to get motivated to get back into flying after a 20-something-year hiatus ended up throwing his budgeted rental money to a new motorcycle because he couldn't find a flight school rental that he felt was worth \$150 per hour. "These aircraft are rough around the edges," he told me. I guess it ain't easy climbing out of a new Lexus and plopping your Dockers on a ripped Cherokee seat. But what about owners who keep decent aircraft parked because they can't afford to fly them?

The management at California-based Plus One Flyers—the oldest and largest flying club in the country—believes it has found the ultimate solution to both problems. It has nothing to do with making a profit, but more about sustaining aircraft ownership. Plus One's president Tom Reid calls it the magical triangle that'll work for any flying club.

The triangle consists of aircraft owners, flight instructors and rental pilots—nearly 1600 total—who are all members of the decades-old club that operates at four California airports. Instead of buying aircraft, the club leases its aircraft from member owners. It's a diverse fleet: from Bonanzas and Cirruses to Citabrias and Senecas. The aircraft owners remain independent in the sense that they are free to remove the aircraft from the club at any time, plus the owner manages, maintains and sets the rental rate (which includes the fuel) of their own aircraft.

The other leg of the triangle is that club members have access to over 100 independent flight instructors who are required to be dues-paying club members. Plus One makes it clear that it isn't a flight school and it doesn't operate to make a profit (it's organized as a 501(c)(7) mutual benefit corporation). Plus One charges every new member a \$99 initiation fee, plus a \$31 monthly fee (waived for aircraft owners) for access to any aircraft in the club. The club is managed by board-appointed officers and 15 member-elected volunteer board directors. Two-thirds of the elected directors are aircraft owners and there are over 70 aircraft in the club. The club maintains a strict code of conduct and requires members to attend regular safety meetings. Plus One provides a broad set of uniform managed services, including web scheduling, automated rental payment billing and collections, monthly reporting and a commercial insurance policy, which covers each member as a named insured pilot. There's also an insurance deductible plan, which is a budget set aside to help pay for things above and beyond the normal wear and tear of use. If a member pilot breaks something, the plane's owner can get it replaced at the club's expense.

The club pays the aircraft owners each month, based on the airplane's rental hours. While there is no management fee, the club takes 3 percent of the rental charge that is used to pay credit card servicing fees. The club found that appropriately priced aircraft that fly an average of 45 hours per month tend to return 100 percent of the operating cost to the owner. Of course, if an owner prices the airplane too high or doesn't keep up with improvements (including aesthetics), it won't rent. A huge flying club by any standard, Plus One discovered that a roughly 1:20 aircraft/active member ratio works well. There's competition among aircraft owners, which keeps rental prices in check. Got a hangar the renter can park in while out flying? Your airplane may have an advantage compared to another owner's plane that's parked outside.

Reid—who put his new Cirrus (and a 182) in the club several years ago—admits that a flying club leaseback isn't for every aircraft owner. You'll have to accept that the airplane will get used, perhaps not as gently as most owners would like. But in Reid's case, the rental income paid for a new engine, maintenance and it helped pay back the loan early. Reid—a finance guy—says he would personally counsel anyone interested in starting a similar model. Plus One Flyers is at www.plusoneflyers.org. We'll look at the hard economics of a flight club versus flight school leaseback arrangement in an upcoming article.—Larry Anglisano



LED LIGHTING APPROVAL

I want to replace the taxi lights on my Piper Malibu with LED equivalents. This seems to be quite the grey area. My airplane came from the factory with the Whelen A775 series recognition/taxi lights. There is no TSO or PMA for these units because Piper approves the installation under the original type design. Whelen recently introduced the 71888 series, which are fit, form and functional equivalents to the original A775. It would be a simple installation because I could literally just drop them in place of the old lights. The problem is that these aren't TSO'd and Whelen apparently has no intention of getting a TSO for them because there is no TSO for recognition/taxi lights. So how do you go about legally installing them? Getting a one-time field approval would be the only way, but how do you do that with so little technical data to justify it to the FSDO?

Greg Wroclawski
via email

You're doing the right thing by trying to install these lights legally. The outcome is really in the hands of the installer. If it determines that dropping these lights in place of the existing ones is a minor modification, a signed logbook entry will suffice. If not, it's time to solicit a field approval. This might not be as difficult as you think if the installer follows the FAA's field approval checklist. The inspector will likely want to see proof that the new light draws equal or less current than the old one and that there are no structural considerations. If you can find previously approved data, like a Form 337 signed by the FAA, it should be easy.

SLIDE-IN ADS-B

I have a Garmin GTX327 transponder in my Van's RV-7A. In the ADS-B transponder article in the November 2016 issue of *Aviation Consumer*, you wished that Avidyne's AXP340 ADS-B Out transponder was compatible with Garmin's GTX327 transponder

wiring because it would be convenient to slide the AXP340 in its place. I have a broader question.

Why hasn't any other manufacturer come out with a compliant ADS-B Out transponder that is a slide-in replacement for the popular GTX327? Ideally, there would be an option to wire in a GPS signal from an appropriate unit, including a GNS430W, to name one approved position source.

For those with the popular Garmin GTX330 Mode S transponder, the now discontinued GTX-330ES provided an easy path to ADS-B compliance, but that's not the case with a GTX327. Garmin could have done this with the current GTX345 series ADS-B transponder, despite it being the same height and width as the GTX327, but it didn't. That creates additional expense and effort for owners like me.

I'm convinced there's a significant market waiting for someone to fill this large niche. Am I missing something?

John Goldsmith
Livermore, California

The Garmin GTX345 wouldn't fit in the GTX327 mounting tray because it has a deeper chassis, which was also the case with the older GTX330.

Shops we spoke with noted that repinning the new connector to accommodate the GTX345 (or any other current rack-mounted ADS-B transponder) can generally be accomplished in a couple of hours or less, if the wiring is in good condition.

WEIGHING IN ON THE BEECH SIERRA

I'm writing to tell you how much I enjoyed the Beech Sierra article in your recent (November 2016) *Used Aircraft Guide*. It presented the Sierra in a good light.

However, there were some inaccuracies. The gross takeoff weight never increased, but the empty weight did increase during model progression. My airplane is probably typical for a B24C and has an empty weight of around 1820 pounds and has a full

fuel payload of around 605 pounds.

The early Sierra models (A24-R) were really the fastest. The POH quotes 140 knots true at altitude, albeit at over 12 GPH. It was typically the lightest Sierra and has the longest propeller. As you noted, the C24R is the end of the line and was really the best to own. As a Sierra owner and A&P, I have done a few minor aerodynamic cleanups. I typically see 140 knots true on roughly 9 GPH.

At the Beech Aero Club, we really try to help our membership. I will probably sell my Sierra in the near future, but will probably always be a club member.

Marty Vanover
Technical Director, Beech Aero Club

MORE MAINTENANCE ARTICLES

I was saddened when I heard that your sister publication *Light Plane Maintenance* is being suspended. *Aviation Consumer* is my other favorite magazine and hope that more maintenance articles will appear in it.

Carl Carlson
via email

We plan to do just that, Carl. If there are specific topics that LPM readers want us to cover, tell us and we'll do our best.

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Stemme S12: Touring and Soaring

With a Rotax 914 engine, an autopilot/EFIS and baggage space, Stemme's S12 offers the best of two worlds.

by Larry Anglisano



Stemme's Twin Voyager S12 next-generation motorglider might be the ultimate niche aircraft. It's not intended for IFR flying and carrying more than two people is out of the question. Despite an impressive 53:1 glide ratio, it's not regarded as a competition glider, although it has set world records. But for as many things as the German-made S12 is not, it does so many things well enough that, like previous S-series models, it promises to thrive in a class of its own.

AIRCRAFT FLIGHT TRIAL

As Stemme prepares for its first S12 U.S. delivery this December, we spent a couple days pawing and flying D-KSIZ—the certification flight test aircraft—at Stemme's U.S. headquarters in Columbia, South Carolina, to see just what the growing list of buyers get for its \$369,000 starting price.

CERTIFICATION MATTERS

The EASA-certified S12 is pending FAA certification under FAR Part 22 (motorglider) and an airworthiness certificate is expected in the coming months. While it waits, Stemme isn't holding back deliveries. Aircraft de-

livered before FAA certification will be operated in the experimental category. To legally fly the S12, you need a glider rating and a logbook endorsement from a CFIG holding a motorglider endorsement. We suggest getting solid training before flying the S12 alone, especially if you don't have experience operating at high altitudes (it has a 32,500-foot service ceiling). It's also a taildragger, although it doesn't exactly handle like one on the ground.

The side-by-side-seating, carbon fiber S12 is a derivative of the shorter-winged S10VT, which will remain in Stemme's lineup. Previous Stemme motorgliders, including the discontinued S6 and current-production S10VT, have a reputation for being complex aircraft and they are. The landing gear is retractable and in the S10VT and new S12, so is the propeller, which the pilot stows in the fully closable nose dome via push/pull mechanical levers.

The carbureted and turbonormalized liquid-cooled engine in the S12 is based on the certified four-cylinder Rotax 914 F2-01. Stemme slightly modified the 914 (repositioning the air induction and turbocharger mounting scheme, to name a couple of tweaks), so it sits in a steel tube

CHECKLIST



The wings are easily and quickly folded for storing the S12 in a standard T-hangar.



It has excellent fit and finish, an economical Rotax engine and is suitable for traveling.



With a price that flirts with \$400,000, the S12 serves a narrow market.

frame in the midsection of the aircraft, just aft of the occupants. This places the engine near the aircraft's CG, which is favorable when it comes to pitch control and stability. The tailplane is of a "T" design and the wing (all 82 feet of it) is mounted to the fuselage in the upper third. With 215 feet of wing area, the S12 is as much a sailplane as it is an airplane. There's an inner wing with flaps and Schempp-Hirth airbrakes, foldable outer wings with continuous ailerons, two wing extensions with ailerons and two winglets.

The Stemme S12, top, might not be a competition sailplane, but it has bragging rights to world speed and altitude records.

The engine is connected to the variable-speed composite propeller (designed by Stemme) with a composite driveshaft. The propeller's manual pitch change from takeoff to cruise position is accomplished by electrically heated expansion elements, and from cruise back to the takeoff pitch position by unheated elements via spring force.

Two fuel tanks are located at each end of the inner wing, which supply the feeder tank in the fuselage via electric fuel pumps. Fuel is supplied to the engine by a main pump, or with a backup auxiliary pump. Total available fuel capacity is 32.3 gallons.

AVIONICS, LOADING

The S12 has practical avionics, but that's not to say it has a stark panel. While buyers can choose—to a point—what equipment they want, the motorglider will be type certified with Dynon's EFIS-D10A and AP74 autopilot, plus an electric trim system. It's a huge challenge getting an autopilot to work well with a wing of this size, but we found it to work reasonably well in calm air. Worth noting is that engine torque and a sideslip rolling moment tend to slightly lower the S12's right wing during fast cruise at high power settings, although we didn't notice any issues while the Dynon AP74 was engaged.

Since it's only designed for cruise flight and not for approaches, the autopilot won't even engage at speeds under 60 knots. It tracks a course from the NMEA output of a Garmin aera 660 or GPS796 GPS. Missing is a pricey GTN navigator because frankly, it just isn't needed in this VFR machine, plus it wouldn't fit.

The S12 we flew had a Slovenian-made LXNav LX9070 soaring computer/variometer and mapping system, and there's an option for a FLARM traffic awareness system. New to soaring? You'll learn early on (hopefully not by experience) that midair collision risk in glider ops, particularly during soaring events, is stupidly high—as in be ready to bail out of the thing. But, glider-to-glider FLARM systems are taming that dragon. Stemme delivers the S12 with ADS-B In and Out, a Becker transceiver, Becker transponder, a fuel flow computer and round-gauge backup instruments.

Total pressure, static pressure and



The S12's huge canopy is designed to be jettisoned should you need to bail out, top photo. Unless your hangar can accommodate the S12's 82-foot wingspan, you'll be folding the wings to put the aircraft away, middle. With leather seating, the S12's cabin has a high-end feel, bottom, but we wished for more lumbar support.



TEC (total energy compensated pressure) are measured with a detachable pitot tube on the propeller dome.

Standard is an engine bay fire warning system, which generates an audible alert with the landing gear warning horn, and optically with a red warning light on the panel.

The S12 has an empty weight of 1521 pounds and a maximum takeoff weight of 1984 pounds. Stemme listened to owners of previous models

and included a luggage compartment that's accessed through a door on the tail boom. It holds a maximum of 44 pounds and can accommodate soft duffel bags. When traveling with the S12, leave your golf bag and snowboard at home—this machine is not a hauler. There is a lower storage compartment located behind each seat that accommodates 22 pounds of stuff.

Stemme added a water ballast tank



The S12 has a busy instrument panel and the pilot's position is dominated by the Dynon EFIS and autopilot control head. Levers for the flaps and airbrakes are perfectly placed, middle photo. The 5-foot-long, two-level airbrakes make for seriously steep descents, bottom.

in the tail to help with CG control when the aircraft is loaded with heavy occupants. Filling (up to 15 liters) is done by pouring water in the right shell of the vertical tail. A scale directly beside sealable holes shows the corresponding water amount.

FLYING IT

As you might expect, taxiing the motorglider with its 82-foot wingspan presents some challenges. Barely clearing the hangars and fuel trucks on the ramp, the wings overhung the edges of the big main taxiway at South Carolina's Columbia Metro Airport. Hydraulic disk brakes are operated with a lever on

each control stick—no toe brakes.

Compared to other conventional gear aircraft, the S12 is easy to taxi because it has a large tail boom and a steerable tailwheel. The S12 is significantly easier to handle on the ground thanks to a wider main landing gear stance, compared to the S10. A wider stance is also required for the S12's longer wing.

With the propeller in the takeoff position and cowl flaps open, we used the 115 percent maximum takeoff power setting (limited to five minutes), which is roughly 5500 RPM. The throttle has two stops: push straight forward for 100 percent power and then push the lever slightly to the left and forward for 115 percent power.

Hold a tail-low configuration and the S12 levitates off the runway. With Stemme U.S.A.'s Wes Chumley coaching from the right seat, the ground roll was approximately 600 feet and we saw a climb rate of around 600 FPM. Set a 62-knot climb speed and retract the main landing gear, which takes roughly 40 seconds to fully retract. In a maximum continuous climb configuration, we saw fuel burn in the 7.5 GPH range, which yielded a 300 FPM climb rate at 90 knots.

Controlling whether the left or right fuel tank feeds the engine is straightforward with a panel-mounted selector valve. The auxiliary fuel pump is switched off when passing 1000 feet in the initial climb. It's easy to speed up to a cruise configuration thanks to manual flaps that can be deflected upward, or in a negative configuration. Cycling the propeller into cruise pitch mode (or from cruise to takeoff) takes approximately two minutes.

The S12 has pleasant handling characteristics. The flight controls are pushrod driven and the rudder system uses cables. The rudder pedals are adjustable, but the seating position is not. Stemme added an electric pitch trim system to the S12, which makes it easy to trim for level flight. Once in cruise, the motorglider has long legs and impressive speed. Stemme publishes the S12's maximum cruise speed at 140 knots true at 10,000 feet. In a no-wind scenario, you could fly for 950 nautical

YouTube See a video of the S12 flight evaluation at <http://tinyurl.com/j95ht2a>

miles. The Rotax can burn as little as 5 GPH and it's approved to run on ethanol-free premium unleaded gasoline and 100LL.

The appeal of the S12 is the ability to shut its engine down and soar wherever and whenever you wish. To do that, the propeller's pitch is cycled back into takeoff mode and you'll

want to reduce the power to keep the CHT and oil temperature below 212 degrees Fahrenheit.

With the cowl flaps fully open, the Rotax cools quickly, which helps to reduce the risk of overheating during engine restart. Before shutdown, the airspeed is reduced to approximately 54 knots.

Once slowed and cooled, simply turn the ignition off and you are now in sailplane mode. The S12 is equipped with a propeller brake to stop its windmilling, which reduces wear on the propeller clutch. Pull the brake handle, turn off the fuel and close the propeller dome.

The optimum speed to maneuver the sailplane is between 65 and 70 knots. The amount of adverse yaw you'll experience depends on the amount of aileron input. With the huge wing, be ready for lots of rudder input. Even so, crank the sailplane into a steep bank with the right amount of rudder input and the S12 is easy to maintain in coordinated flight. Again, it's nice having the weight of the engine close to the CG. Less aileron input still results in a decent roll rate without the need for lots of rudder input. Plus, it has impressive roll stability. Set a roll rate, dial in a touch of up trim and the sailplane will fly that configuration hands off all day long.

Slips aren't approved with the gear down because of the gear doors and the S12 is not approved for spins, although they have been demonstrated. Aerobatics aren't approved. With a stall speed of 42 knots, the S12 offers plenty of warning before it stops flying. There's buffeting, but no dramatic wing drop. We were able to get it to break to one side during an aggressive pull, but relaxing the stick immediately got the wings flying again.



WING FOLDING: HOW EASY?

The reality of owning a motor glider with an 82-foot wingspan is that you'll have to deal with folding and unfolding the wings, should you store it in a typical personal hangar. Fortunately, Stemme has made the task much easier on the S12 than

it was with its S6 model, which required several people and at least an hour to accomplish. We had our hands in the task when we flew the S12, and while it may be a deal breaker for some (those who

are physically and strength challenged), the mechanical process is quite straightforward.

The folding/locking mechanism on the S12 is identical to the one used on the S10VT and once you've attached and detached the wing

sections a few times, the task can be accomplished in roughly 15 minutes.

What you're really doing is attaching and detaching the outer wing extensions—not the entire wing. When folded back, the wing rests on the surface of the tail boom making it possible to pull the motor glider in and out of a standard 40-foot hangar.

To fold each wing, unsecure the attachment pin with a lever mounted on the underside of the wing, pull outward and pivot the wing aft toward the tail boom. To reattach, pick the wing up, walk it back, slide it into position and lock it. It really is as easy as Stemme says it is.



Transitioning back to the powered configuration requires slowing below 76 knots. Turn the fuel on, open and lock the propeller dome, open the cowl flaps and move the propeller into the takeoff pitch position. Since the Rotax is carbureted, you'll need to turn on the choke when the engine is cold. Set the power to idle and turn the ignition to the start mode for a few seconds. An automatic electronic device adds the ignition with a three-second time delay, which allows the propeller blades to fully deploy before the engine starts. Once the engine starts, turn the ignition to "both," advance the throttle to 2000 RPM and come off the choke as the engine warms. Landing can be done in powered or gliding configuration.

For landing, the changeover of the propeller blade pitch can take up to five minutes, so you need to be mindful of it in case of a go-around. The landing gear is extended at 59 knots and total extension time is roughly 30 seconds. The airbrakes are a huge tool for speed control throughout the approach and landing phase. With them fully extended and the propeller dome closed, the glide ratio is 7:1 at 59 knots. You don't want to flare too low in this aircraft because of its tall

landing gear, and touchdowns are made in a three-point attitude.

WHO BUYS 'EM?

"In general, folks aren't going to buy the S12 for serious Open Class competition soaring because there are cheaper alternatives. Plus, it would be like bringing a Ferrari to a Formula One race," said Stemme U.S.A.'s Wes Chumley. Still, Chumley has flown the S12 in contests (and won) and Stemme motor gliders have set world distance records. A Stemme was recently used to reach and soar above the peak of Mount Everest.

But for more pedestrian pilots who can afford the eye-widening \$369,000 starting price, the S12 is about convenience. The ability to self launch and motor—at decent speed—to the best soaring conditions you can find without having to trailer it back to the hangar has sizable appeal, in our view.

The S12 is delivered to and assembled by distributor Stemme U.S.A., a division of the respected Bell Aviation in West Columbia, South Carolina. There is also an established and growing North American service and maintenance network to support the product after delivery.

Contact www.stemme.com.

Upset Training: Recurrency is Key

Loss of control is the leading cause of all GA accidents. Here is how you might train to greatly reduce your risk.

by Rick Durden

In 2015 there were 384 deaths in general aviation accidents. According to the FAA, the cause of the majority was loss of control (LOC). The FAA's definition of LOC is an unintended departure of the aircraft from controlled flight. We think that the discussion of LOC should be more encompassing.

Of concern to us—which became part of the impetus for this article—is that *Aviation Consumer's* research into aircraft accidents on a model-by-model basis for its monthly Used Aircraft Guide points to LOC as the cause of the majority of all general aviation accidents, not just those involving fatalities. We think the definition has to include operations while the aircraft is on the ground—either during rollout after touchdown or on takeoff.

In the materials the FAA has put out focusing on LOC accidents, it points out that in virtually every one of those accidents the pilot either initiated the LOC sequence through his or her actions or could have broken the chain of events leading to the accident with appropriate control inputs.

Pilot responsibility for LOC accidents leads to the follow-up question as to what a pilot can do to up her or his skill set through training. The convenient excuse that the pilots who suffered LOC events simply didn't have the "right stuff" doesn't cut it. There is extensive research—notably by NASA—as to why smart pilots have accidents. We know LOC accidents aren't limited to dumb pilots. What has been learned is that

avoiding LOC accidents requires training that allows a pilot to recognize a developing hazardous situation, overcome the "startle" or terror reflex when suddenly presented with an aircraft upset/departure from controlled flight (or rollout) and act appropriately.

REDUCING YOUR RISK

For a general aviation pilot who wants to take steps to reduce his or her exposure to the greatest risk of having an accident, what training is out there, what is involved and what does it cost?

The answers are that there is a surprisingly large number of organizations and individuals offering upset and LOC avoidance training; the training should be done in an aerobatic airplane (with parachutes—required by FAR 91.307) and you should come out of it capable of safely dealing with the majority of upset/LOC risks faced by GA pilots.

You should be able to complete an upset/LOC in VMC course in two days, with four or five flights and six to 12 hours of ground instruction for \$2000 or less. We saw a number of upset courses consisting of one hour of flight and one hour of ground school. We do not recommend any of them because we do not feel they can cover the subject in the time available.

In this article we'll describe how to find an upset/LOC training facility, break down LOC accidents so you can explore your exposure to them and go into detail as to what we think should be in a loss of

control training syllabus, and why, so that you can work with an upset/LOC training instructor to tailor an effective program for yourself at a price you can afford. We've included a list of elements that should be in what we consider to be a good upset course in a sidebar on the last page.

We found that the best spot for locating upset training is the International Aerobatic Club's website (www.iac.org) under its aerobatic school reference. Choosing a trainer, after you have read the remainder of this article, involves the same process you've followed in choosing a good CFI—discuss what you want to accomplish, listen to what the CFI says and decide whether you feel the instructor will work with you to challenge you, keep you comfortable during what may be some uncomfortable flying, will tailor a course to your needs and whether the two of you can communicate effectively.

BREAKING IT DOWN

LOC is a huge topic. Our review of ICAO and FAA publications on the subject and several thousand ac-

You only meant to look down at your iPad for a moment to get some airport data. But you fat-fingered the inputs in turbulence and it took longer than you intended and when you looked up you saw the horizon where you'd never seen it before. Now what do you do?

Ground instruction is integral to upset training. Instructor Catherine Cavagnaro briefs a student on what to expect in the airplane, right, above. A student reacts as instructor Patty Wagstaff demonstrates an exaggerated nose-up pitch attitude, below.



cident reports as well as teaching aerobatics for many years led us to the conclusion that LOC needs to be broken down into three distinct areas: RLOC (runway loss of control)—losing control on the ground, LOC-I (inflight) VMC—loss of control inflight in visual meteorological conditions and LOC-I IMC—loss of control inflight in instrument meteorological conditions. We'll look at the most common causes of each and then at how upset/LOC training can be targeted at those causes.

We note up front that our review of accident data and reports of deployment of ballistic parachutes in aircraft equipped with them has made us of the opinion that they have prevented a number of LOC-inflight accidents.

We also note that those who have studied all types of LOC accidents write that contributing causes include: poor judgment, failure to recognize an impending or full stall and execute corrective action, intentional disregard of FARs, inexperience, lack of proficiency, failure to follow standard operating procedures and reduced ability to think or act due to fatigue or intentional use of meds or drugs that inhibit cognitive ability or motor skills.

RLOC

Runway loss of control makes up from 20 to 65 percent of general aviation accidents—broken down by airplane model. The higher end represents tailwheel airplanes. RLOC accidents are rarely fatal, but injuries are not unusual and the damage suffered is often enough to total the airplane. Most all RLOC accidents occur on landing, although about one out of 15 is on takeoff.

To the extent data are available, the common thread behind the accidents is a crosswind, too much speed on final, touchdown well above stall

speed and failure to use all available aerodynamic control on rollout.

In our interviews with upset/LOC instructors all pointed out a reluctance of pilots to put a control to the stop—and that many had never done so. That, combined with the need to manage excess energy due to a fast touchdown, means an increased risk of LOC during rollout.

Stalling while on final accounts for just 1 to 2 percent of all GA accidents, yet CFIs told us that many private pilots they flew with were so uncomfortable with flying at the POH approach speed that they tacked on from 10 to 30 knots. Four-time national aerobatic champion and aerobatic school proprietor, Patty Wagstaff (www.patty-wagstaff.com), referred to “watching people land at warp speed.”

When speed is doubled, energy is quadrupled—that basic equation spells out the problem of aircraft control on rollout. It means a swerve will be more powerful and the needed action to stop it more forceful—which means that the pilot must be ready to put the rudder to the stop. Extra speed on touchdown also means that the airplane has a longer period of deceleration before it reaches taxiing speeds, where there is good rolling control. During that period of exposure, the tires aren't developing enough friction to keep the airplane going straight and aerodynamic control—which is diminishing with speed—is the only method



of directional control. Catherine Cavagnaro, who runs Ace Aerobatic School (www.aceaerobaticschool.com), described pilots dealing with impending loss of control events in the air and on the ground as “so shy with the rudder.”

FULL CONTROL DEFLECTION

We are of the opinion that one of the most effective ways for a pilot to improve his handling of an airplane on takeoff and landing is to take some aerobatic instruction—or at least some upset/LOC training. We've explored the matter in more detail in our sister publication AVweb at <http://tinyurl.com/grbouuh>. It tremendously improves a pilot's confidence in handling the airplane at low speed. Being comfortable coming down final on speed, touching down

TABLET COMPUTER APPS FOR IMC BACKUP

Historically, an additional attitude indicator and/or vacuum source were the only backup options available for instrument or vacuum failure in IMC—and they weren't cheap. Plus, a renter pilot had virtually no chance of finding a rental with such backups. With tablet computers and apps that tie in with ADS-B receivers providing instrument displays, I've been curious if they are a satisfactory alternative to trying to fly partial panel. Do you still have to invest in an additional attitude indicator or vacuum source?

To find out, I set out to use the ForeFlight 8 app on an iPad Mini with a Bluetooth connection to a one-year-old Stratus 2S portable ADS-B receiver. My standard for success would be modest—keep the airplane upright, under control and be able to make turns, climbs, descents and speed and configuration changes. I decided that “under control” would be holding altitude within 200 feet, heading within 20 degrees and airspeed (in this case, groundspeed) within 20 knots. Those were not adequate for shooting an instrument approach to minimums, but they were, in my opinion, safe while getting the airplane to VFR flight conditions.

I used a Cessna T210L because, in my opinion, high-performance singles are the most difficult airplanes to hand fly in IMC, especially in turbulence.

On a VFR day, with a safety pilot and under the hood, I set up level cruising flight with ForeFlight 8 showing the map display. I had not practiced using the instrument backup display in some weeks. I covered all of the flight instruments with sticky notes, a process that took 10 seconds. I waited five more seconds before trying to activate the backup instrument display. I then realized I didn't recall which icon to push. That added to the delay in obtaining attitude and altitude information. While it's difficult to simulate the startle and fear response a pilot experiences when placed in a loss of instrumentation situation, using up some 20 seconds after the instruments were covered before coming up with the correct icon to push was a step in that direction. Once the backup display (split screen with map) appeared the airplane was in an accelerating, descending right turn with bank increasing.

The ForeFlight display proved intuitive enough that it was easy to level the wings and resume level flight before safety pilot Dan Travis started to hyperventilate.

Over the course of the next 20 minutes I made turns, climbs and descents in light to moderate turbulence and tried to convince Denver Approach to give us a practice approach into Centennial Airport. They were overloaded and, after a series of “standbys,” advised they could not do so. I was interested to notice that an ordinarily simple matter

of trying to negotiate a clearance with ATC significantly increased the workload and degraded my ability to fly the airplane precisely. Had the situation been real, I would not have hesitated to declare an emergency.

I was able to keep the airplane within the parameters I'd established, and got better with practice, although I frequently would enter a bank unintentionally and wander off heading. The screenshot, left, was taken during the flight.

The iPad was on a yoke mount, which made viewing it easy. That changed with any repositioning of it to an angle—as one might do mounting it to one side of the panel, or on my lap as on a kneeboard. Having to turn my head or look down increased the workload and had the potential for bringing on spatial disorientation.

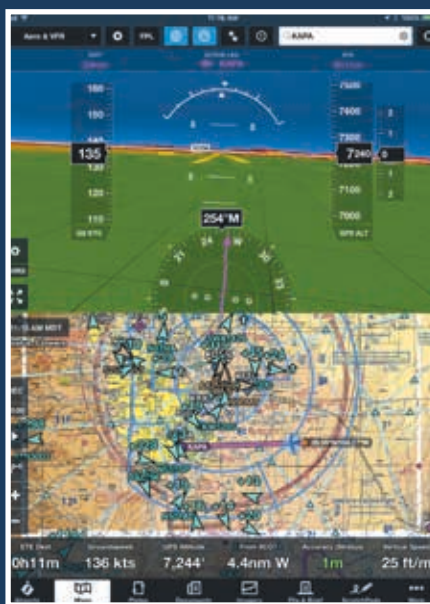
I decided to simulate a total electrical failure in the airplane, a 500-foot ceiling and an airport without an instrument approach. I planned to fly directly to the airport, using the terrain-alerting features of ForeFlight as well as its synthetic vision.

When I extended the gear and approach flaps, I found that dealing with configuration changes using the standby instrument presentation was no big deal, although it was challenging to establish a desired descent rate. Reaching 500 feet AGL just inside two miles from the airport and pulling the hood resulted in needing a very simple heading change to line up with the runway and land.

Conclusions: The standby instrument presentations on tablet computers (at least an iPad and ForeFlight) have reached a level of sophistication that, in my opinion, allow a high-performance single-engine piston airplane to be safely flown to VFR flight conditions in an emergency. It's far easier than partial panel flight using a turn coordinator. The key word is emergency—it's not unusual for an iPad, Stratus unit or the ForeFlight app to shut itself down for one reason or another. In my opinion, a pilot who would intentionally fly in IMC with such a display as sole reference is a fool, and might be considered criminally negligent if he has an accident while carrying passengers.

If there is an electrical failure in a glass panel airplane, the backup battery has a 45-minute life. Out west, that may not be adequate time to get to VFR conditions or reach an airport with an instrument approach. The battery life of a Stratus unit and iPad could potentially mean the difference between success and a mess.

I also think that it's essential to practice using the backup instrument display on a tablet—instrument skills deteriorate with alacrity. *-Rick Durden*



While smoke isn't necessary for an upset recovery aircraft, we like the Decathlon for the training—instructor Greg Koontz demonstrates his, right, above. Handling crosswinds is a part of LOC prevention—a Pitts Special demonstrates an exaggerated slip to a landing, below.

slowly in a crosswind and putting the controls to the stop as needed will, in our opinion, dramatically reduce a pilot's risk of RLOC.

We recommend that a portion of the syllabus of any upset/LOC training include takeoff and landing practice, including steep slips to a landing.

LOC-I VMC

The majority of fatal LOC crashes occur in VMC. The causes are consistent—stalls at low altitude (most commonly shortly after takeoff, a go-around or a buzz job, with traffic pattern stalls in second place), upsets into steep banks and, surprisingly, near the bottom of the list, spins.

In our opinion, upset/avoidance LOC-I VFR training should concentrate on three areas: low-energy/low speed/high AOA (whether the pitch attitude is high, level or low), diving spirals with the airspeed well above cruise and increasing and upsets involving overbanking—from 60° to nearly inverted (because the natural reaction to pull is precisely the wrong one).

At the low-speed end, training should include recognition that it takes some altitude for a stalled airplane to enter a developed spin. Many accidents classified in the “stall/spin” category involve stall events in which the ball is not centered—which results in an aggressive roll and pitch down that may be an incipient spin or a spiral.

Most general aviation airplanes will not enter a spin unless the pilot continues to assertively apply pro-spin controls. However, when the stall, roll and pitch down occur at below 1000 feet AGL, whether the sequence is an incipient spin, diving spiral or spin is a distinction without a difference—there is a dramatic loss of altitude. Usually, there is time and



altitude to recover if the pilot recognizes what is happening, breaks the stall by pitching down and stops the roll with the rudder. Too often the pilot has “a too-long ‘Duh’ moment” to quote Catherine Cavagnaro, and the airplane hits the ground.

In many such accidents, the witness statements could have been written with a rubber stamp: “I saw the airplane flying slowly, the wings seemed to be wobbling and then one wing dropped and it dove into the ground.”

GROUND INSTRUCTION

Upset training is not the same as aerobatic training. In aerobatics the pilot is intentionally placing the airplane into unusual attitudes. In an upset, the unusual attitude is not intended, comes as a horrible surprise and may not have been seen previously by the pilot. Upset training accordingly requires ground instruction on the distinct mental and physical demands of recovery. It also teaches a pilot to recognize that a deadly LOC chain is developing and how to stop it.

The syllabi we saw for what we considered satisfactory upset recovery training included at least one hour of ground school for every hour in the air. As Greg Koontz, airshow pilot and upset recovery trainer (www.gkairshows.com), told us it's necessary to “lay down a good foundation through ground school—not



just hop in the airplane.” Laying a background helps a pilot dealing with a new situation draw the right conclusion about what to do, especially because some upset recovery techniques are not intuitive.

Such things as the disorienting effects of g-loading and how they can slow a pilot's thought processes to a crawl should be discussed in detail. The goal of the recovery portion of upset training is for the pilot to be ready for the “startle” she is experiencing, handle it, evaluate the situation correctly and apply the techniques necessary for recovery in the altitude available without overstressing the airframe.

Once in flight, Steve Green of the Aspen Flying Club (www.aspenflyingclub.com) told us that it's important to make upsets as real life as possible to show how they can develop. All of the instructors we spoke with said they use various distractions and otherwise routine tasks to induce the pilot to inadvertently stall

UPSET TRAINING ELEMENTS

We recommend that any upset training course include the following elements in its syllabus:

- Aerodynamics—aircraft performance envelope; angle of attack and how a wing stalls; aircraft behavior in an uncoordinated stall; incipient spin recovery; spin dynamics and recovery; control surface function, with emphasis on rudder use and effectiveness; that there are times it is necessary to put a control surface to the stop and that it's OK to do so; trim fundamentals and emphasis on trim effect on recovery from a spiral dive.
- Causes and contributing factors of upsets—environmental, pilot-induced and mechanical and warnings available to a pilot that the aircraft has entered a region of a high risk of an upset/LOC.
- Review of upset accidents and incidents including where recovery was successful and why.
- G-awareness—Effects of g-loads physically and on comprehension and problem-solving; g-load management and airframe limitations for positive, negative and lateral g-loads.
- Energy management—risk of low-energy flight regime and stalls after takeoff or go-around; kinetic

energy versus potential energy versus chemical energy (power); relation between pitch, power and performance.

- Upset prevention and recovery techniques—recognition and intervention before an upset occurs; stall recovery coordinated and uncoordinated (stopping the roll with immediate rudder input); spin recovery; diving spiral recovery; nose low and nose high low-energy recovery; high bank angle/inverted recovery.
- System malfunctions—autopilot/automation; instrument; jammed controls and stall warning failure.
- Runway loss of control—energy management; appropriate approach speeds; rudder and aileron use while rolling on takeoff, landing and go-around; response/recovery to directional excursions.
- Human factors—startle/threat/terror response (physiological, psychological and cognitive effects); situational awareness; human information processing; inattention, fixation, distraction; perception illusions; instrument interpretation; active monitoring; threat and error management; fatigue management; workload management and crew resource management (usually single-pilot).

the airplane or enter a diving spiral or steep bank.

Cavagnaro told us that she often sees pilots who are overly concerned about the slow-speed portion of the flight envelope and not cautious enough about the high-speed end. She spends time going over what the airframe will and will not tolerate—the limitations and misconceptions of maneuvering speed, flutter, the yellow arc in turbulence and what will happen above redline.

She shows that recovery from slow-speed upsets needs to be done quickly and assertively—high-speed upset recovery is a more gentle affair.

WHAT AIRPLANE?

The right airplane should be aerobatic while being as representative of the airplane the pilot regularly flies

as possible. Because most aerobatic airplanes use a control stick instead of a yoke and have tandem rather than side-by-side seating, all CFIs we spoke to recognized that things aren't perfect. It was agreed that a roll rate comparable to that of the pilot's regular ride was important, especially when dealing with a steep bank upset. The instructors felt that the pilot should experience the need for full aileron deflection and get comfortable with putting the aileron and rudder to the stop.

The list of airplanes that developed included the American Champion Decathlon and Citabria, Cessna 150/152 Aerobat and Beech Aerobatic Musketeer.

The Aerobat ranked especially high because so many LOC accidents are low-energy, low-altitude stall events,

so training in lower-powered aerobatic airplanes is valuable. It allows a pilot to see that the nose doesn't have to be pointed straight up to stall the airplane at full power and get used to flying the airplane very near the stall and then accelerating to a safe climb speed without losing altitude.

LOC-1 IMC

Most of the LOC in IMC accidents resulted in high-speed ground impact or inflight breakup. Virtually all of the inflight breakups involved thunderstorms or severe turbulence. Yet, thunderstorms were not the primary instigators of LOC in IMC.

Many pilots simply couldn't keep their airplane upright even when all the instruments and avionics were working. To the extent reasons were found, they were consistent over the years—ill health affecting ability to control the airplane, incapacitation, lack of recent instrument experience, no—or very little—instrument experience, distraction, being overloaded, spatial disorientation and/or vertigo.

Some LOC in IMC events had mechanical failure in the accident chain. Vacuum pump failures in IMC in high-performance piston singles are high-risk affairs. In our opinion, unless a pilot has had recent recurrent training flying partial panel and is very good at it, the chances are high that he or she will lose control of the airplane, especially if there is any turbulence and the pilot is trying to fly using a turn coordinator.

We recommend that upset training for IMC repeat the unusual attitude recoveries in the VMC course but do them by reference to a full panel of instruments and then partial panel, but using any backup instruments and/or tablet computer instrument backup app the airplane and pilot have available.

We also recommend that a pilot install or obtain some additional instrument reference be it standby vacuum, an additional attitude indicator or tablet computer app tied to an ADS-B receiver.

CONCLUSION

Because LOC is the most common cause of GA accidents, we recommend pilots take targeted initial and recurrent upset training. Besides improving your skills and confidence markedly, it's a lot of fun.

SureFly SIM Ignition: Maintenance Free

SureFly's drop-in electronic ignition may not offer more power, but it has an engine-matching TBO, is easy to install and promises maintenance-free reliability.

by Jim Cavanagh

After years of hemming and hawing, the piston aircraft engine industry could be finally coming to its senses by embracing electronic ignition. Electroair has been selling electronic ignitions for a couple of years, and now SureFly—a company stemming from Sky-Tek (starters) and Plane-Power (alternators)—is nearing FAA certification of an electronic replacement it calls the SIM, for SureFly Ignition Module.

I recently visited with Granbury, Texas-based SureFly for a close look at the product. Here's a report.

ANCIENT HISTORY

You know, we fly some pretty darned interesting machines. They are made as lightweight, strong and redundant as possible considering the materials needed. If the electrical system fails, the engine will keep running thanks to technology developed for cars in the late 1800s.

The spark plugs do their job because of the magnetos. Think of magnetos as small generators that create electricity independent of the electrical system by spinning a magnet in an electric field. Andre Boudeville developed the first low-voltage mag, but the high-voltage (or tension) magnetos were developed in 1889 by Fredrick Richard Simms and Robert Bosch, with the addition of a coil. These created a high-voltage spark that was needed for ignition

The SureFly electronic mags for four-cylinder and six-cylinder engines, shown at the right, use the existing ignition harnesses and require no software programming.

systems in automobiles. Some used a secondary coil to increase the voltage and some presented the charge directly to the spark plug.

For aircraft engines, magnetos were a godsend because they were independent of the electrical system, fairly compact and relatively lightweight. Aircraft engines were designed with two spark plugs per cylinder and two mags simply as a means for keeping the engine running should one of each fail.

I once lost an alternator in a Grumman Tiger after taking off in New Mexico. Rather than being stranded, I simply turned off the electrical system and flew the airplane (in Piper Cub fashion) back to home base. A rebel, perhaps, but I might not have tried this with just one magneto on the engine.

Electronic ignition retrofits for aircraft engines have been around since the early 1980s. Klaus Xavier sold the Light Speed system starting around 1986, and these have worked on plenty of experimental aircraft

CHECKLIST



SIM electronic mags require no routine inspection or service until the engine reaches TBO.



Installation can generally be accomplished in a couple of hours or less.



FAA certification is pending, so they're off limits to certified aircraft—for now.

engines—relatively problem free—for three decades. But since things in the certified world seem to drag on, electronic ignitions haven't gained traction. Change could be in the air.

COSTLY CHALLENGES

There are two challenges in bringing electronic ignitions to market and in a way, they're both related. One is a price-sensitive market and the other is dealing with the rigors of FAA certification. The certification effort is incredibly costly and ultimately passed down to the consumer. Moreover, it would seem that the FAA hasn't been exactly welcoming of electronic ignition technology.

Developers (including SureFly) recognized this and have pursued STCs that require the retention of the right-hand direct-drive mag (or typically the one without the impulse coupling), while replacing the left mag with the electronic unit. Retaining one mechanical mag retains some system independence from electrical requirements—significantly easing certification efforts.





The SureFly mag mounts to the engine the same way a traditional mag does, top. That's the engine drive side of the SIM, middle. The electronic SIM mag is slightly larger than a Slick mag, bottom.

ignitions. Jason Hutchinson, SureFly's general manager, told me the SIM electronic ignition (which is expected to be certified in the coming months) was designed in only 30 days. The idea was to keep it simple, dependable and inexpensive. Essentially, the

SIM is designed to directly replace and do what a traditional magneto does—no more. SureFly built several prototypes and installed them on the Lycoming engine in Hutchinson's RV-6 and on the engine of an experimental Bellanca Viking.

Like Electroair's system, the SureFly electronic magneto is completely solid state. Rather than using spinning magnets and a bunch of anachronistic parts, the concept is to

electronically convert battery power into a high-voltage signal and pulse it to the right cylinder at the right time. Like the Electroair system, the SureFly ignition uses standard wiring harnesses for a given engine.

The beauty of the SureFly system is its simplicity. One unit is basically the same size and weight as a Slick mag and a couple of pounds lighter than a Bendix. There are no moving parts, it's fully electronic and it requires no software updates.

The electronic mag can be adjusted to any engine's base timing advance (specified on the engine data plate) by a little switching module that is accessible through a large port on the case. There is more spark energy throughout the RPM range and the dwell is adjusted automatically. Each spark plug has its own dedicated coil, virtually eliminating coil failures.

There is no impulse coupling, as the unit controls timing by manifold pressure and RPM. Below 400 RPM, the timing is set to TDC, with a longer dwell and increased voltage, ensuring cold or even fouled spark plug starts.

EASY INSTALLATION

The SureFly SIM is quite simple to install. According to SureFly, it should take an experienced tech roughly an hour to install the first one, not counting disassembly. There are no extraneous boxes or wiring harnesses to retrofit on the engine.

A power wire, ignition switch P-lead and manifold pressure connection are required for the installation. The engine's RPM signal is picked up within the module from the crank gear. Designed to last throughout the TBO of the engine for which it's installed on, there should be no downtime for regular inspections, no messing with the timing or risking the possibility of failures due to these inspections/adjustments.

As for instructions for continued airworthiness, SureFly's SIM installation manual advises, in part, that during the annual or 100-hour inspection one should simply check the installation for engine oil leaks.

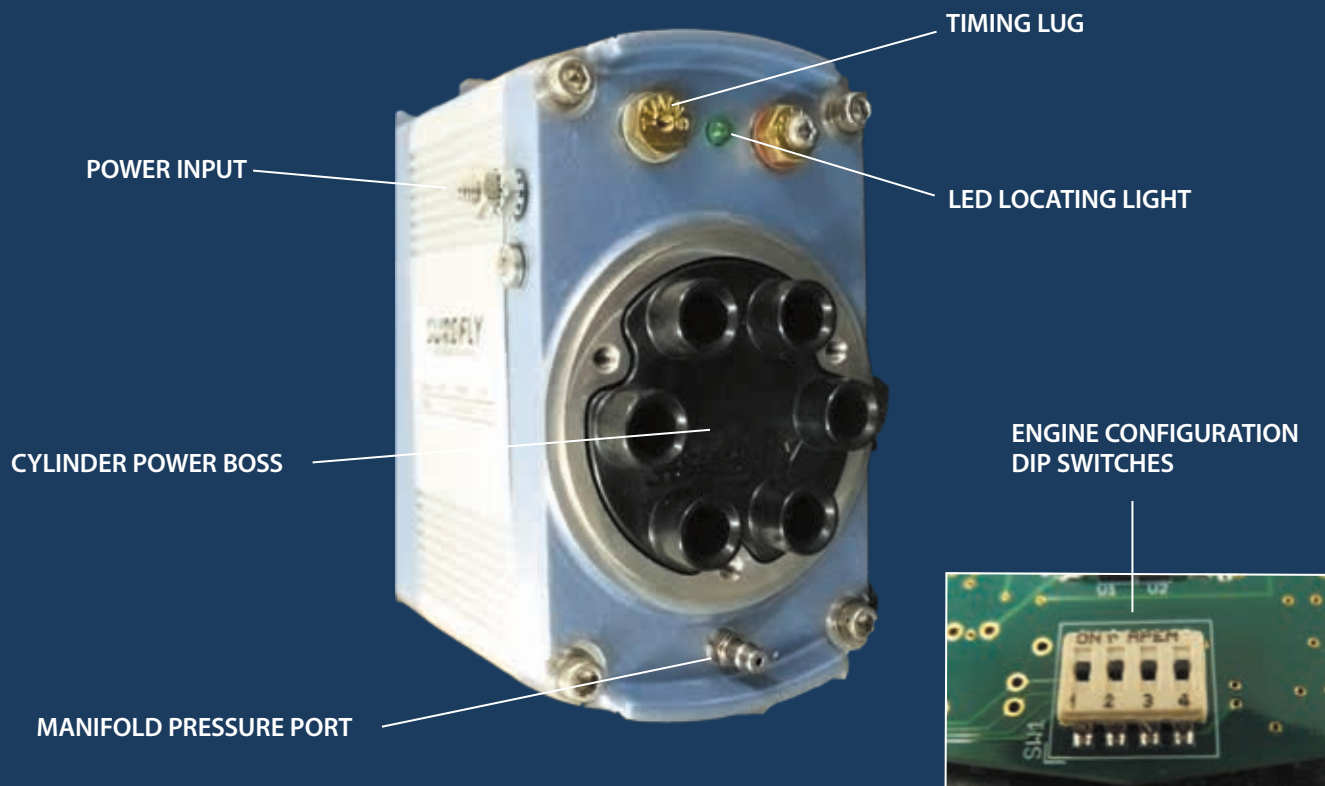
During installation, power is applied to the timing lug and before tightening the base clamps, the unit is moved slightly left and right to ensure that the LED indicator is off.

Michigan-based Electroair has led the field with certified kits for both Lycoming and Continental engines. It obtained its first AML-STC in 2011 and the list is growing. We covered the Electroair ignition in the October 2014 issue of *Aviation Consumer*.

ENTER SUREFLY

SureFly was started by the brainchildren of Sky-Tek and Plane-Power. After selling those companies, the crew began thinking about electronic

SUREFLY SIM OVERVIEW



The power lead is then moved to the power post and the engine is ready for ground running.

VERSUS ELECTROAIR

SureFly is expecting to have FAA certification for its SIM before this coming summer. The SIM for four-cylinder engines will have a list price of \$1250 and the six-cylinder SIM will cost \$1550. Dealer discounting is possible. With disassembly, reassembly, paperwork and testing, typical labor costs should be well under \$500—which is a real savings. The other savings, compared to traditional magnetos, is not having to pay for teardown and inspection. But understand that the SIM doesn't have unlimited life. Overhaul pricing hasn't been determined, but there are simply two bearings and one drive shaft in the four-cylinder version

and two additional bearings for the six-cylinder version. That could keep overhaul costs low.

Once the SureFly SIM is certified, buyers will have to choose between it and the Electroair ignition. The Electroair has a starting street price of around \$1600 for four-cylinder engines and as high as \$2500 for some six-cylinder engines. List pricing is considerably higher. The Electroair system is designed to last until the TBO of the engine.

If performance gains are the motivating factor, buyers will likely be drawn to the Electroair system because it has variable timing, which offers more power and better fuel efficiency. Electroair began development of its six-cylinder model in 2012, and has since received certification of the EIS-61000 system for large-bore Continental engines.

The SureFly SIM was not designed for performance enhancements, although some fuel efficiency is expected. The whole idea was to offer a dependable, low maintenance, stone simple electronic ignition that can be sold for a reasonable price. Remem-

ber, too, that SureFly's SIM will be certified for basically all four- and six-cylinder engines immediately, due to the ability to adapt a common module to every four- or six-cylinder engine.

As it goes in all fields of endeavor, the last guy to bring something to the table has all of the first guys to learn from. In my estimation, the SureFly crew is a sharp bunch, they are all pilots and aircraft owners and they are all thinkers. They've had a proven track record of success from the get go, including their unabashed modification of automotive starters for aircraft application. After all, if it works, why redesign the wheel trying to change it?

For simplicity and for saving space in the engine bay, plus saving weight and reducing installation cost and complexity, the SureFly SIM could be the best choice for an electronic ignition retrofit. On the other hand, it isn't FAA certified yet, which—for now—gives Electroair a sizable advantage.

When he's not drumming in his band Revolushn, contributor Jim Cavanagh flies and wrenches several of his own aircraft.

CONTACT...

SureFly Electronic Ignition
817-373-5161
www.surefly.net

Hiring a Ferry Service: Cost Varies By Complexity

If you and your airplane are separated and you can't go get it, we recommend a professional ferry service. Here's what to expect when you hire one.

by Rick Durden

It seems that one of the branches of Murphy's Law, Aviation Division, takes great glee in occasionally causing an aircraft and its owner to be geographically separated under circumstances where the owner needs outside help to achieve reunification. That's where aircraft delivery companies can make aeronautical life much easier for owners. Whether your machine needs to be moved a few hundred miles or halfway around the world, there are companies that exist to provide that service.

Aircraft delivery services are not regulated, so anyone with at least a commercial pilot certificate can offer to ferry airplanes. In preparing this article we found more than 40 companies offering aircraft delivery services. We called and/or emailed a representative sample and spoke with companies that routinely need aircraft delivered. From our research, we put together some guidelines as to how to approach arranging for a professional service to ferry your airplane, what you should expect from that service and what you can expect it to cost.

We recognize that informal fer-

rying of airplanes goes on all the time—your mechanic is on a field 30 miles away and it's time for your airplane's annual. Your friend Mary has the same type and she's flown your airplane with you. You can't get away from work so you ask Mary to fly your airplane to the shop. She agrees and arranges to have someone drive over and pick her up. Routine, right?

RISK

Yes. But. You and Mary may be putting yourselves at some degree of risk—financial in your case, FAA violation in hers. Before Mary flies your airplane, you need to make sure that you're covered under your insurance policy if she has a bird strike during the flight and the airplane is damaged.

From Mary's perspective, she's doing you a favor, but she's also getting free flying time (unless she pays for the full cost of the ferry flight) and the FAA long ago ruled that free flying time is "compensation" under FAR Parts 61.113 and 61.133, so she has to hold at least a commercial pilot certificate to make the flight. (One of the FAA's interpretation let-

ters on the subject is at <http://tinyurl.com/gn5kbb5>.) Yes, we know, her chances of getting a violation are low. Unless something goes wrong—and then she and you are going to be dealing with seemingly endless red tape from your insurer and the FAA.

Accordingly, we recommend doing some thinking before having your airplane repositioned by someone else. For even the simplest move of a dozen miles we recommend that you make sure the pilot has experience in the same type, meets your insurance requirements and has at least a commercial pilot certificate.

PROFESSIONAL SERVICES

Aircraft delivery service companies advertise on the internet and in various aviation publications. Companies will provide a preliminary quote over the telephone and many have websites that will generate a preliminary quote once you provide information about the airplane, where it is, where it needs to go and when. The quote should reflect the cost of getting the pilot to the airplane and back home after the ferry flight, the fee for the pilot—figure a bare minimum of \$250 per day—going up as the complexity of the airplane and trip increases—fuel for the airplane, meals and lodging for the pilot and some percentage for the company for the cost of coordinating the ferry.

In talking with delivery services we found that some specialize in certain types of aircraft. For example, Sarah Rogner, proprietor of Full Throttle Aviation (www.fullthrottleaviationllc.com), said her company focuses on tailwheel, vintage, experimental and ag aircraft.

Other companies specialize in international deliveries where the paperwork can be dauntingly complex and the airplane may need a ferry tank or tanks installed to carry enough fuel for the trip. The owners of Wings of Eagles Aircraft Delivery (www.weflyplanes.com), Dala and Larry Newsome, told us that they consider themselves a problem-



The ferry pilot's luggage stands beside a new Maule M7-260C in the factory prior to the delivery flight. A breakdown could mean added expenses.

solving business—they primarily do international ferry flights and take care of everything involved with getting the airplane moved.

As we researched this article we were surprised at the number of companies that advertised aircraft delivery services that did not return telephone calls, respond to emails or had full voice mailboxes. Fully half of the companies we reached out to either did not respond or could not be reached. Getting three or four quotes for ferry services for your airplane may require a little patience.

Once you have sorted through the preliminary quotes it's time to talk details with each service so that you can assure yourself that all insurance needs are met, the pilot is appropriately experienced, will fly the airplane in accordance with your wishes and is backed by a company that can be relied on to keep you advised of progress and take care of problems that may arise. In addition, the company can learn about you, your airplane, its history and condition and your preferences in operating it.

Aaron Kahn, the proprietor of FlyIt4U (www.flyit4u.com), told us that this conversation allows him to fine tune his preliminary quote to meet the special requirements of the owner as it affects the planned route, number of stops, time en route, fuel costs and expected expenses.

FULL UNDERSTANDING

We came away from our interviews with delivery company owners believing that it is important for the aircraft owner to fully understand what a delivery service can and cannot do so that there are no surprises if there's a problem during the delivery.

Many delivery services also offer to do prepurchase examinations of an airplane for a prospective owner and then deliver it if the sale goes through. Some have A&P mechanics on staff, others have working relationships with maintenance technicians around the country. If you are considering buying an airplane that is across the country, an aircraft delivery service may be a one-stop shop for the prebuy and delivery.

In addition, some delivery services advertise that they will either have one of their pilots who is a flight instructor ride with you and check you out in the airplane as part of the



delivery process or deliver the airplane to you and then check you out in it.

Once you have the detailed quote and decide to move forward, you should expect to receive a contract for the ferry flight. Look it over carefully and make certain it reflects the agreement you think you made. There is no standard delivery contract; each of the companies creates its own. Sarah Rogner of Full Throttle Aviation explained that it took time and money to come up with a contract that allowed for the variables involved in ferry flying as she and her company have experienced it. She, and others, told us that the company and the pilot have to be prepared for anything from a routine trip to showing up and discovering that the airplane described by the owner as pristine is an unairworthy loose assembly of parts.

The contract should explain what you will pay if all goes according to plan and any additional costs that you will face if the airplane breaks or weather interferes with progress.

While most delivery companies can respond very quickly to move an airplane—we heard one story of a company getting a pilot to an airplane the day after the owner's buddy had abandoned it in the middle of a ferry flight—we were told that most of the time the company and its pilot will watch weather forecasts and do the ferry flight when it appears there will be a weather



The delivery pilot should perform a detailed preflight and make a squawk list on first reaching the airplane, top. While maintenance problems are not common on delivery flights, we recommend that all stops be at airports with maintenance facilities, above.

window that minimizes the risk of delay once started.

Once the pilot gets to the airplane you should expect that he or she will do a very detailed preflight, note any squawks and inform you. Live chat and cellphone video have greatly simplified solving problems found on the preflight, especially when the airplane is not in the condition the owner claimed. The ferry pilot, as PIC, has the last word regarding whether he or she will fly the airplane in its current condition.

You should receive regular reports of progress—at the very least a text

BAD WX OR BROKEN AIRPLANE

While aircraft delivery companies told us they do their best to plan ahead and take advantage of forecast good weather windows so as to avoid weather delays and it's uncommon for an airplane to break during a ferry flight—the world doesn't always go according to plan.

What happens if the weather does close in or your airplane breaks partway through the delivery? Specifically, are you going to be paying a daily rate, motel and meals for a pilot who is sitting on the ground? Are you obligated to pay for expensive repairs at a shop you don't know to get the airplane on its way?

The answer to the "what if something happens during the delivery" question should be absolutely clear to you and the delivery company—in writing—before the ferry pilot goes to pick up the airplane. In our conversations with delivery companies we were told that the delivery contract specifies who is responsible for what should the delivery be delayed by weather or maintenance issues.

The policies of the companies differed slightly, although the common thread was that the pricing builds in a little pad that allows for delays, the delivery companies will usually eat the cost of weather delays and the owner usually is charged for the cost of maintenance delays.

Delivery companies told us that they do not want their pilots to be under pressure to go in marginal weather so if they quote a flat rate for the delivery the price includes an allowance for a short weather delay (to protect themselves). They do not charge the owner anything for the time the pilot can't fly due to weather and they work hard to make the flight when they think the weather will cooperate.

When it comes to a maintenance

delay, all of the companies we spoke with said that the owner is charged for the pilot's downtime and per diem. There are some ferry companies that employ pilots who are also A&Ps, but it's not common. You should expect that if there is a problem, the pilot will stay engaged, get the airplane to a shop on the airport, be present for troubleshooting and involved in the loop with you as you make decisions regarding needed parts and maintenance.

In an era of overnight parts delivery an AOG situation can often be resolved within a day. We do recommend that you specify that all stops during the delivery be made at an airport with maintenance services. We've ferried airplanes and had them break.

The delivery services we spoke with said that they have worked with owners where a maintenance problem involved getting a ferry permit to move the airplane to a location where it could be fixed. They also told us that should there be a serious problem that cannot be fixed quickly—one mentioned an engine condition requiring overhaul before further flight—the pilot will work with the owner to get the airplane secured appropriately and then return home, bringing that particular delivery agreement to an end.

When a ferry pilot arrives to find the aircraft is not airworthy, the companies we spoke with said that they will immediately advise the owner and get a decision as to what the owner wants to do. Most of the time the owner directs that needed repairs be made and agrees to pay for it. Sarah Rogner of Full Throttle Aviation told us that her company's practice is that if the owner declines to have the airplane fixed she will return home and refund the customer's money minus the costs she has incurred.

You should also expect the ferry pilot to treat your airplane as his or her own. Kasey Lindsay, one of the owners of Northwest Backcountry Aviation, an American Champion and Maule dealer, told us that when his company pays to have an airplane ferried it is when it is coming new from the factory. He said that he wants the airplane to arrive in as nearly perfect condition as possible, so the ferry pilot should do all the little and big things that help keep the airplane pristine such as avoiding runups on surfaces that risk damage to the paint on the prop and hangaring the airplane each night.

The route is at the discretion of the pilot; however, in our conversations with delivery companies we were told that the pilot keeps cost to the owner in mind. They will try to select airports where fuel is less expensive, although as Aaron Kahn of FlyIt4U said, "The airports with the cheapest fuel tend to have the fewest services." That matters if the airplane breaks or if it's the end of the flying day and the pilot has to find transportation to food and lodging.

All of the delivery companies we spoke with said that their delivery flying is limited to daylight operations. In the summer pilots try to fly eight to nine hours each day. As the days grow shorter, so does the time spent in the air.

Once the airplane arrives we think that you should receive a written list of squawks noted during the trip as well as some sort of log with information on each leg including time, power setting, altitude, fuel flow and fuel burn and all pertinent receipts.

CONCLUSION

We recommend that if you need to have your airplane moved any distance that you make use of an aircraft delivery company to assure the process goes smoothly and that problems that may crop up are solved quickly and efficiently because they've probably seen it before.

Nevertheless, the companies are not regulated, so it's *caveat emptor*—do all that you can prior to the flight to get all of your questions answered, make certain the airplane is insured appropriately, understand clearly what the company will and will not do and what it will cost you.

after each landing and before each takeoff. Some companies use SPOT

trackers so the customer can track the flight in real time.

Stratus 2S ADS-B In: Good Used Market Buy

We flew the Stratus 2S portable ADS-B receiver for over a year to see how it would hold up. It proved solidly reliable in virtually all weather.

by Rick Durden

As the market saturates with panel-mounted ADS-B gear, we're seeing portable ADS-B receivers hit the used market at bargain prices. This includes the popular current-gen Appareo Stratus 2S. Just prior to AirVenture 2015, the Stratus development team—Appareo handling hardware, ForeFlight for software and Sporty's for sales and support—released two new models of its portable ADS-B receiver: the 1S targeted at VFR pilots and the 2S designed for IFR operations. The new models included additional features and addressed a history of hardware issues. Having had extensive hardware problems with the earlier model, I was curious about the reliability of the new units.

With a 2S aboard, I made a 2300-NM trip, including a flight into AirVenture 2015 with editor Larry Anglisano keeping a critical eye on its performance. Now, after more than a year of using the 2S in an ADS-B Out-equipped airplane, I've been impressed, overall, with the features, functionality and reliability of the 2S. It hasn't been perfect, but the few shortcomings are easily outnumbered by its virtues.

THE BAD

The biggest problem I had with the Stratus had nothing to do with the unit itself, but with the RAM window mount included with the receiver. It would fall off the window, no matter what my aircraft partners

The Stratus 2S has a good ADS-B receiver, but the window mount just wouldn't stay in place, right.

and I did short of gluing it in place. It seemed almost malevolent, somehow falling when pilot workload was highest. Fortunately, the 2S was never damaged. We switched to a glareshield mount.

Locating the Stratus on the dash did once cause a heat-induced shutdown when the airplane was parked in the sun, something Appareo warns about in the manual.

THE GOOD

The 2S always fired up and got a GPS lock fast. In 90 hours of flying, I never felt it needed a remote antenna. While I did not ever need the AHRS-provided backup attitude, altitude and groundspeed information to help out after a vacuum pump failure, it was nice to know it was just a button-push away. When called up, it always appeared in moments and was accurate.

After having gone through 18 months of frustration with hardware issues on the older model 2, the reliability of the 2S was refreshing. The weather presentation was always clear and reliable. During the year I compared the ADS-B weather radar data with XM radar and found they almost invariably agreed. The quality of traffic information was good most of the time. Occasionally an airplane being displayed simply disappeared or the two panel-mounted units would alert for nearby traffic and nothing would appear on ForeFlight.

Appareo warns in the manual that the nature of the ADS-B traffic system is such that not all traffic will be observed by the receiver, even if it's in an ADS-B Out aircraft. I think the experience I had with inconsistent quality traffic information on the Stratus was more likely due to the current vagaries of ADS-B rather than a shortcoming of the receiver. At least for now, it's nice to have a panel-mounted traffic receiver that is not reliant on ADS-B for traffic information.

CONCLUSION

After a year of flying in all kinds of weather behind the Stratus 2S (\$899 at www.sportys.com), I've greatly appreciated the reliability over the previous model as well as the number of features it offers.

Other than being dissatisfied with the window mount, I have been impressed with the Stratus 2S performance. If you find one that's been well cared for, I think it's a solid used-market buy.



Masimo MightySat: More Than a PulseOx

It's a four-in-one wireless personal health monitor made for pilots and athletes. Third-party aviation app compatibility could increase utility.

by Larry Anglisano

When we reviewed Masimo's ISpO2 pulse oximeter a couple of years ago, we thought it was feature-rich and liked its useful tablet interface, but dinged it for its tethered design. The finger sensor with a 30-inch cable proved too cumbersome for our liking.

But Masimo's latest-gen finger pulse ox device—the MightySat—changes that for the better with a wireless Bluetooth tablet interface, plus a sophisticated feature set that caters to both pilots and athletes. Masimo is marketing the device through select Apple stores, BestBuy and Amazon, to name a few outlets.

After using the MightySat for a month, we think it's the most advanced biometric device available to

pilots, even though its price might be a stretch for budget-conscious pilots with basic missions. For high-flyers and athletes, we think it packs a solid punch. Here's a close look.

CLINICAL SMARTS

Based on 2014 data research, Irvine, California-based Masimo is the leading manufacturer of hospital pulse oximeters and the MightySat trickles down from high-end clinical instruments. Using patented technology it calls Signal Extraction Technology (SET), the MightySat fingertip device uses five parallel signal processing engines that Masimo says results in more accurate readings. This helps counteract undesirable sampling conditions pilots face in the cock-

CHECKLIST

-  MightySat's hospital-grade design promises better accuracy and reliability.
-  Wireless connectivity with Masimo's Personal Health app makes it a useful training tool for athletes.
-  With a \$400 retail price, the flagship MightySat might be a stretch for basic missions.

pit—including hand movements (shaking and vibration) and low blood flow (low perfusion) when the fingers are cold, for example. In a recent clinical study, Masimo's SET measuring technology was shown to be more accurate than 19 other pulse oximeter models under motion and in low perfusion conditions.

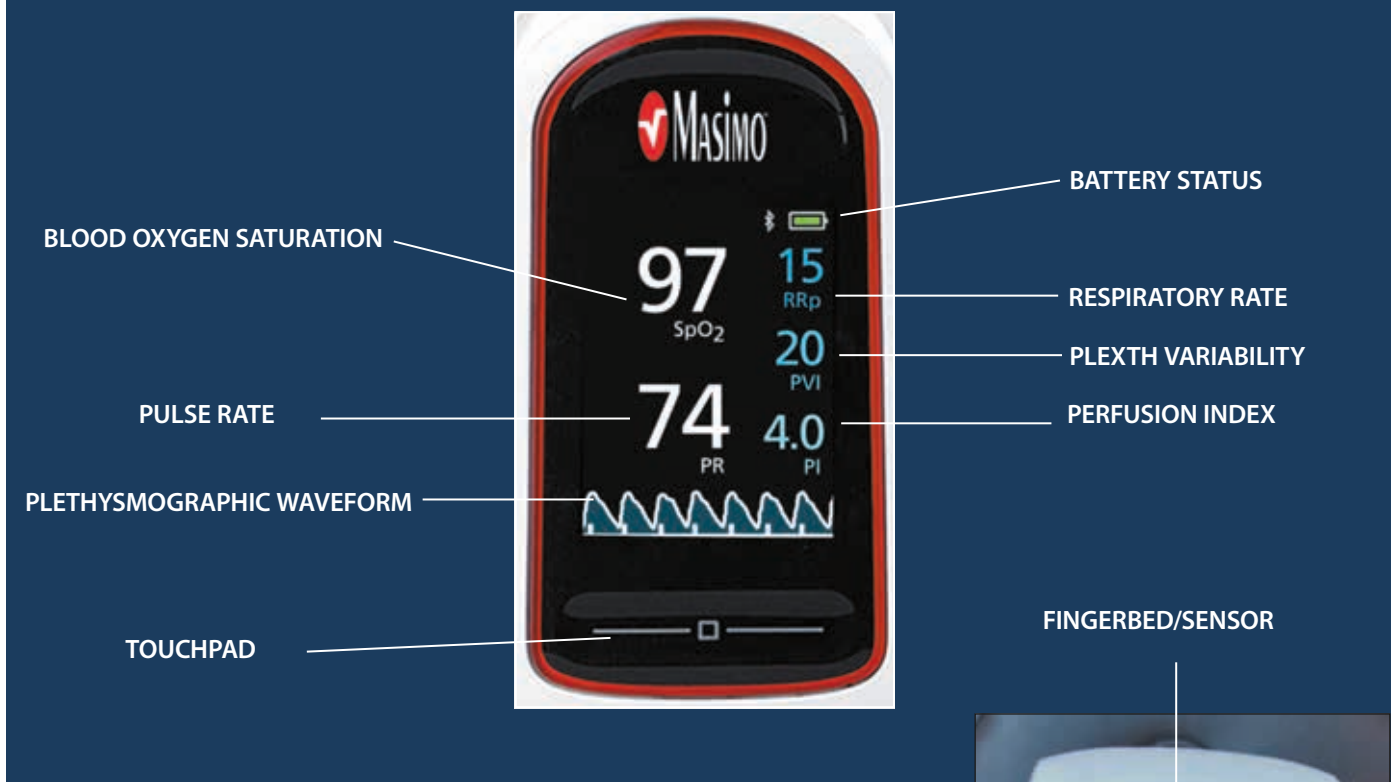
The MightySat comes in two versions and both have a four-year warranty. There is the \$299 MPH-9800, which displays oxygen saturation, pulse rate and perfusion index, while the \$399 MPH-9900 (evaluated here) adds respiratory rate and pleth variability index. Both have Bluetooth connectivity and we used the device with the current iPad Mini and with an iPhone 7, noting quick pairing.

Aside from oxygen saturation, a key displayed parameter on the MightySat is the perfusion index, or PI. This is the ratio of the pulsatile blood flow to the nonpulsatile blood flow in peripheral tissue. Simply put, a lower PI value indicates lower blood flow. Masimo stressed that there is no specific normal value for perfusion index. Instead, each individual should establish their own baseline value and note how it changes over time. In our use (for flying and during distance cycling training), our PI remained relatively constant except when it dropped significantly on a cold morning in an unheated cockpit and also during the



The MightySat, left, has a sunlight readable 1.3-inch high-res color display and a touchpad for changing the orientation and other setup functions.

MIGHTYSAT AT A GLANCE



first part of 35-degree bicycle ride.

Masimo packs a lot of data on the MightySat's color display, but we found it easy to read at a glance even in sun-splashed cabins and in low lighting conditions. The device runs on two AAA batteries and there is a battery strength indicator at the top of the display. Based on 50 hours of operation with the display brightness at 50 percent, you can expect approximately 1800 measurements at 30-second spotchecks.

As you would expect, the device turns on and off automatically when a finger is inserted into and removed from the padded sampling pad. An internal spring mechanism places the right amount of sampling pressure on the finger, so resist the temptation to squeeze it on the finger because doing so will provide inaccurate readings.

Like most other finger pulse oximeters, a sensor shines a visible red and an infrared beam of light through the finger to detect the changes in color of the arterial blood.

While the display is not a touchscreen, it does have a small touchpad, which is located just below the

screen. It's used to access the main menu, which has settings for rotating the screen clockwise for four different configurations. The pad is also used for turning on the Bluetooth LE transmitter for pairing to a smart device running the Masimo Personal Health application (compatible with iOS and Android), for changing the display brightness and for turning the plethysmographic (pleth) waveform function on or off.

We initially thought the pleth waveform function was more gee-whiz than useful, but it's really an important tool for monitoring the changes in arterial blood flow as your pulse changes. Pleth waveforms and their variations are used by clinicians to get a better read on signal integrity, unwanted electrical interference and changes in perfusion. When displayed, the scrolling wavelength sits at the bottom of the MightySat's screen.

The most important piece of data for pilots—SpO2 or the arterial blood oxygen saturation value—is shown at the top of the display. We compared the MightySat's SpO2 readings (in three unpressurized



cabins) to several other more basic fingertip pulse oximeters, including the SPO Medical PulseOx 5500 and the NoninConnect. The Nonin's SpO2 readings matched the Masimo at every altitude, while the PulseOx 5500 yielded measurements that were consistently higher, by an average of two or three points. Masimo says the MightySat's accuracy spec is plus and minus two, in standard deviation.

UNIQUE FEATURES

While heart rate (the number of beats per minute) and pulse (the mechanical pulse of blood flow through



We think the MightySat is useful for athletic endurance training, making the \$400 price tag tempting. The basic Personal Health app interface is easy to use, but displaying the data on a panel avionics screen would add a layer of convenience.

the capillaries) aren't exactly identical, we found the MightySat's pulse rate measurements—displayed directly below the SpO2 value—to coincide with readings taken with a heart rate monitor on a Garmin

ForeRunner sports watch, which uses a chest strap heart rate sensor. The MightySat has a field showing the respiration rate, which Masimo calls RRp. Measured in breaths per minute, RRp coincides with the changes in the displayed plethysmographic waveform (an algorithm that allows for continuous monitoring during a respiratory cycle) as a scrolling graphic on the lower portion of the screen. The respiration rate function can be especially helpful to athletes who want to quantify their breathing. The idea is to use the device after a peak workout to see how quickly you get back to your baseline breathing rates. Obviously, a rapid recovery rate is proportionate to your fitness level. But for pilots, Masimo believes RRp can be a useful tool for determining a potential hypoxic condition. Key symptoms of hypoxia include rapid breathing and a rapid heart rate.

Another MightySat function that trickles down from clinical-grade monitors is the pleth variability index, or PVI. The PVI is used

to evaluate a patient's fluid status, but Masimo believes the function is useful to pilots and athletes who want to keep tabs on their hydration. As a general rule, if the PVI value is high, then dehydration could be a concern. For athletes, hyponatremia/overhydration (lower PVI readings) can be dangerous. On the other hand, Masimo cautions that pilots and athletes relying on the MightySat's PVI function generally aren't in a controlled environment and the resulting spontaneous breathing causes unwanted signal noise, which leads to inaccurate readings. The drill is to first establish a baseline PVI (a value between 10-20 is considered normal

hydration), breathe normally for 30 seconds and then take a reading.

EVOLVING HEALTH APP

Via Bluetooth LE, Masimo's Personal Health app displays all of the parameters shown on the MightySat screen (it also works with Apple HealthKit), while storing the data in memory for trending/analysis. You can also email the data, which attaches as a csv file and opens in an easy-to-read chart showing each individual sampling with its date and timestamp.

Still, we think the MightySat interface could be even more useful if it could interface with popular aviation tablet apps, which ideally might warn of hypoxic conditions. Masimo hinted that this capability could be in the works, since it is targeting pilots as a primary consumer. The market for cockpit biometric devices (advanced ones) is stark and the MightySat—with its Bluetooth connectivity—seems perfectly positioned to make inroads. The only cabin biometric panel interface we know of is the Guardian Avionics Aero 455 panel-mounted pulse oximeter (yes, stick your finger into the instrument panel and it takes a reading). It also has an integral CO detector, plus an RS232 serial databus (and also a Bluetooth transmitter) for displaying data on a variety of panel displays, including Garmin's G3X series and G1000. It's compatible with some JP Instruments and Electronics International engine monitoring displays.

We rounded up a handful of finger pulse oximeters for a comparison in the March 2013 issue of *Aviation Consumer* and not much has changed—including the rules in FAR 91.211, which govern the use of supplemental oxygen. We still conclude that oximeters meeting clinical standards are best for cockpit use, whether you fly with supplemental oxygen or not.

As for the Masimo MightySat, it's clearly more advanced than many pilots need in a basic oximeter. But if you're a pilot and a serious athlete, we think it has plenty of utility.

Contact www.masimopersonal-health.com.

YouTube See a video review of the MightySat at <http://tinyurl.com/j95ht2a>

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Mooney 201/M20J

If two-person long-distance traveling is your mission, the 201 is tough to beat for speed, efficiency and comfort.

Mooney's J-model is one of those rare ideal compromises between speed, economy and payload. It's not the fastest retrac on the block, but as complex aircraft go, it's relatively affordable to own, plus it's easy to fly and maintain.

Mooney pumped out nearly 2200 201s between 1977 and 2008 and the current used market has plenty for the taking. There's a lot to like, which makes it easy to overlook some of the aircraft's nits.

As we've discovered in previous used aircraft reports on the entry-level Mooney, owners rave about their 201s, thus it was no surprise that—once again—our query for comments on the airplane drew more feedback than any other model. Here's a look.

HISTORY

Amazingly, even the latest speed champion from what's now called Mooney International in Kerrville, Texas—including the \$769,000, 242-knot Acclaim—traces its heritage to the original Mooney type certificate. The basic airframe has evolved over

the years, but the concept of a semi-monocoque rear fuselage mated to a metal-skinned steel-tube cabin, a long and slender tapered wing and distinctive reverse tail has endured.

The J-model evolved most directly from the F-model, which was itself

aeronautical background, including a stint on the Apollo lunar program at Grumman. He became a near legend for his ability to get the utmost from an airplane through aerodynamic cleanups, which he'd done with success on the Grumman Tiger.

Applying his magic to the M20F model, LoPresti and the Mooney team created the M20J. A number of changes were made, the most visible being a new cowling and a more aerodynamic windshield. The interior was addressed, too, with adjustable seats

and a contemporary flat panel with organized electricals and circuit breakers rather than the typical dog's breakfast arrangement of the 1960s and 1970s.

The old Mooney naming conven-

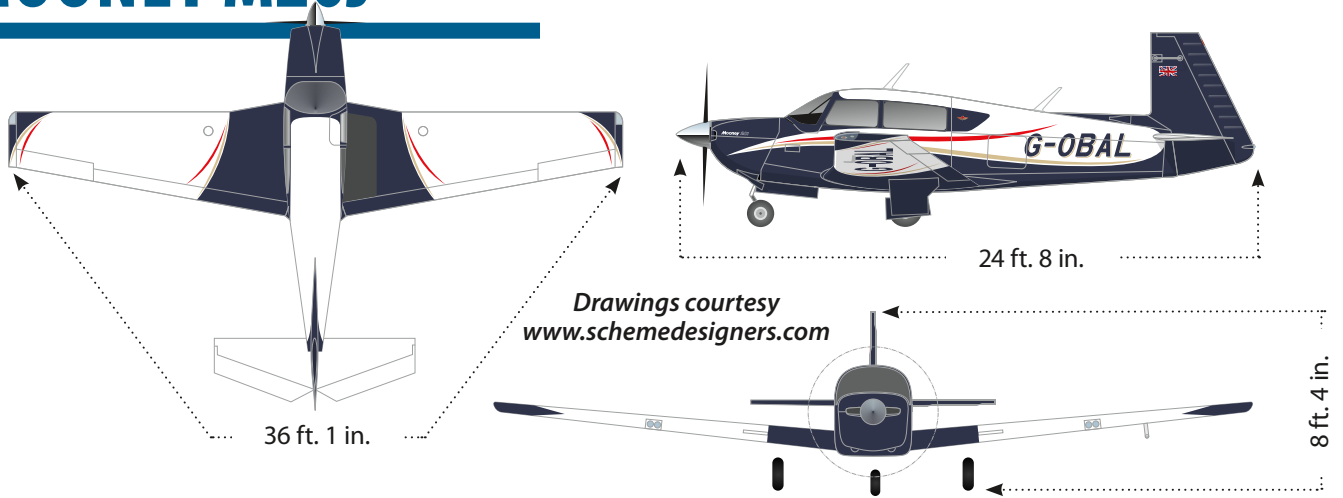
Landing a Mooney is easy once you learn to fly slow enough across the numbers.

descended from the short-body C-models of the mid-1970s. The first J-model or 201—the number derives from its supposed top cruising speed in MPH—appeared in 1977. It sported a 200-HP Lycoming four-banger—the IO-360—improved landing gear and a sloping windshield, among other changes. All of these were the product of a concerted effort by Mooney to kick the model line up a couple of notches.

The 201 is, to the surprise of many, very much the work of the late LeRoy LoPresti. LoPresti had a long

That's Robert McGuire flying his 1998 Mooney 201 Allegro over the New England landscape. With the right winds and power setting, he can make Connecticut to northern Florida nonstop.

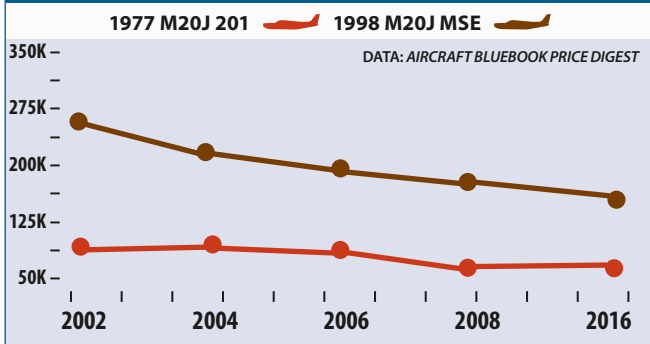
MOONEY M20J



MOONEY M20J/201 MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1977 MOONEY M20J 201	LYCOMING IO-360-A1B6D	2000	\$30,000	64	1069 LBS	170 KTS	±\$68,000
1984 MOONEY M20J 201	LYCOMING IO-360-A3B6D	2000	\$30,000	64	1069 LBS	170 KTS	±\$84,000
1985 MOONEY M20J 201 L/M	LYCOMING IO-360-A3B6D	2000	\$30,000	64	1069 LBS	170 KTS	±\$80,000
1988 MOONEY M20J 201 L/M	LYCOMING IO-360-A3B6D	2000	\$30,000	64	1069 LBS	170 KTS	±\$77,000
1988 MOONEY M20J 205 SE	LYCOMING IO-360-A3B6D	2000	\$30,000	64	1030 LBS	171 KTS	±\$101,000
1992 MOONEY M20J MSE-LIMITED	LYCOMING IO-360-A3B6D	2000	\$30,000	64	1030 LBS	171 KTS	±\$125,000
1992 MOONEY M20J MSE AT	LYCOMING IO-360-A3B6D	2000	\$30,000	64	1030 LBS	171 KTS	±\$100,000
1992 MOONEY M20J MSE	LYCOMING IO-360-A3B6D	2000	\$30,000	64	1030 LBS	171 KTS	±\$105,000
1998 MOONEY M20J ALLEGRO MSE	LYCOMING IO-360-A3B6D	2000	\$30,000	64	1030 LBS	171 KTS	±\$165,000

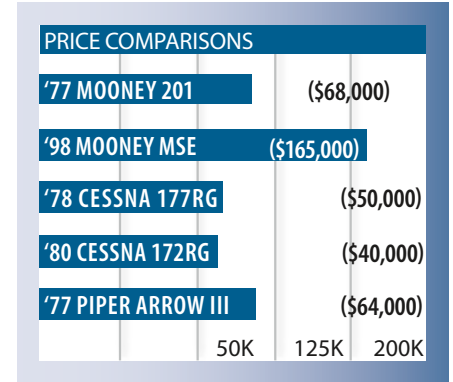
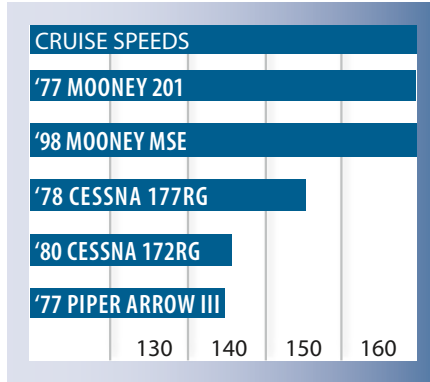
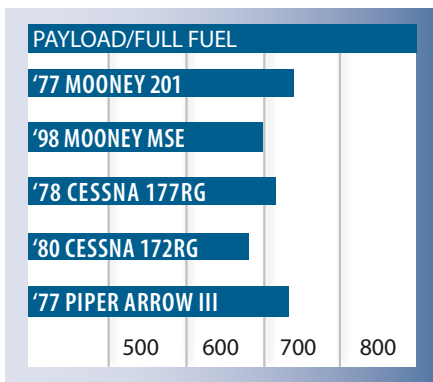
MOONEY M20J/201 RESALE VALUE



SELECT RECENT ADs

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

SELECT LATE-MODEL COMPARISONS





Quotes for avionics upgrades might include a “Mooney factor” premium because the radio stacks are riveted in place and the wiring is shoehorned behind the panel. Late-model 201s have taller panels, lower photo, offering more real estate to work with.

tions—Executive, Chaparral, Statesman—were chucked in favor of the top speed moniker. To be fair, it should really be more like a Mooney 184, since this model doesn't honestly cruise at 175 knots. As a marketing ploy, Mooney even went so far as to reserve as many 201 registration numbers as possible for the new airplanes. Even by 1970s standards,

the 201 was a smash hit, selling more than 1000 copies in the first four years.

By 1985, the general aviation slump was taking its toll so Mooney started up the J into the 201 LM (for “Lean Machine”), a stripped-down version with basic IFR avionics for a bargain price. Two years later, the M20J got some more tweaks (gear doors) and was renamed the 205. Inexplicably, the 201 was still being produced, as was the 201 LM. Mooney was selling three airplanes that were more or less the same: all M20Js, but with different equipment. In 1988, the 201 was dropped and the 205 became the 205SE.

BRING BACK THE 201

By 1989, Mooney realized it was simply confusing customers and

returned to the 201 name. That same year, a trainer version was introduced, called the AT. It was intended only for flight schools and is notable for the inclusion of speedbrakes. The new ones we flew at a busy aviation university had minimal avionics—rare for the model that's usually loaded.

In 1991, Mooney abandoned numerical names and re-dubbed the 201 the MSE. There was a version with special equipment in 1992 called the MSE Limited. In 1993, all special variants were dropped and just before it abandoned the J-model, Mooney gave it one more name: the Allegro, ostensibly to go along with the Ovation and the Encore, the redo of the 252 that was also dropped just after it reappeared. Very few Allegros were made, but they're arguably the most luxurious of the 201 litter.

Total production of the M20J—regardless of name—totaled about 2150 with about 1600 registered in the U.S. The airplane retains a loyal following and the fact that demand for it remains strong is evidenced by price trends: The 201's base price more than doubled in the first six years, from \$46,725 (1979 base) to \$97,500 (1985). On the used market, the 201 continues to be a strong seller. Long gone are the days when a clean model would fetch \$200,000, but a mid-1980s J or LM will still command about \$90,000. A good one will sell quickly, even against lower-priced hangar queens.

EVOLUTION

Here is a rundown on the more significant changes to the series: The biggest operational shortcoming of the original M20J was its low gear-operating speed (V_{lo}) of 107 knots for both retraction and extension.

This, together with the low flap extension speed (V_{fe} of 114 knots), caused pilots grief in high-density areas and led to the airplane's reputation as a hot-handling, hard-to-land performance machine, which it really is not.

V_{le} (gear extended speed) and V_{lo/e} (maximum gear operating/extend speed) were increased to 132 knots for the 1978 model year. The 107 knots maximum retraction speed remains. Even these speeds are low, given the slickness of the

airframe. Speedbrakes were offered as a factory option in 1986 and aren't a bad feature to have; you can retrofit the Precise Flight boards to any model.

Where the first 201s have throttle quadrants with a pistol power lever, carried over from the C-model, in 1978 this was changed to conventional push-pull engine controls. The panel and central console/pedestal were redesigned twice. In 1980 (1981 model year), the panel and glareshield were changed to the same configuration as that in the 231, with the extended section over the radio stack to provide more room.

This change also is credited with solving vibration and rattling that had been an annoying problem in earlier 201s. For all its reliability, the IO-360 isn't the smoothest engine out there. The ventilation system also was improved and the shaped wingtips with faired navigation and strobe lights that were first introduced on the 231 were added.

Further aerodynamic and several serviceability changes were made for the 1984 model year. The nosegear doors were redesigned to make them close fully on retraction, a fairing was added to the tail cone and a one-piece belly fairing was installed. This is a desirable feature; otherwise maintenance access to the belly is a pain. The single fairing, which is fastened with 38 Dzus fasteners, replaces eight separate access panels with 175 screws. Engine access was improved, too.

Over the years, empty weight increased by roughly 80 pounds; basic empty weight was 1640 pounds in 1981, 1671 pounds in 1984 and 1726 pounds in 1992. Some versions have more than 200 pounds in optional equipment and end up with full-fuel payloads around 460 to 470 pounds. In any case, don't plan on much more than 600 pounds with the tanks full.

The big changes in the 205 were in the electrical system and landing gear. The 205 electrical system is 28 volts compared to the 14-volt system in earlier M20Js. The higher-capacity system is an improvement even though the 70-amp maximum output of the alternator is unchanged, because it can produce 70 amps whereas the earlier system is capped out at roughly 60 amps.



The seats in the top photo were reworked by Aero Comfort (www.aerocomfort.com) in San Antonio, Texas. The company will also update the control yokes to match the ones in later models. A Hartzell three-blade scimitar prop is mated to the IO-550 engine in Seth Meyers' Rocket Engineering Missile conversion, bottom.



Battery rating also increased. Along with that, Mooney added an improved electric load monitoring system to supplement the high- and low-voltage annunciators—idiot lights that don't help manage demand to any great extent.

The 205 gear system incorporates the M20K doors that fully enclose the gear when retracted and is the major contributor to the modest claimed speed increase of 4 MPH. The mechanical, three-position cowl flaps were replaced by an electrically operated, infinitely adjustable system.

We like the manual flaps better, but they need to be kept in adjustment.

Gear speeds were raised to a V_{lo}/extend of 140 knots and V_{le} of 165. A flap preselect system was offered for the first time and V_{fe}/approach (15 degrees) was raised to 132 knots. The higher speeds were lost when the 201 returned in 1989.

MOONEY M20J ACCIDENTS: LANDINGS

Our review of the 100 most recent Mooney M20J accidents revealed that although the greatest proportion fell into the “landing related” category, the news regarding landing those machines is quite good compared to other airplanes. To start with, there were so few landing accidents overall, 26, that we lumped the usual suspects—runway loss of control (RLOC), overshoot landings, hard landings and blown go-arounds—into one category rather than listing them separately.

For nosewheel airplanes, we would not be surprised to see 26 RLOC events alone—there were fewer than 10. We think a total of 26 landing-related accidents is an indication that the M20J series has above-average landing manners.

We do note that an M20J will float if final is flown too fast and may well bite if the pilot doesn't get it slowed down before putting it on the ground. One owner tore up his airplane after coming down final at AirVenture at the speed of heat. When he neared the colored dot he had been told to land on he forced the airplane onto the runway. Not surprisingly, his M20J played pogo stick—bouncing repeatedly as it ran off the runway—eventually to be stopped by some heavy military vehicles that happened to be between it and rows of parked airplanes.

We add a cautionary note to our praise of the M20J's landing manners. Of the 26 landing-related accidents, more than 10 involved a prang on go-around from a landing that had not gone well. Proper rudder inputs, applied assertively, are necessary when the power is advanced on a go-around.

We found nine fuel-related accidents in our review. That seemed about right for an airplane with a fuel system that doesn't have a “both” or “on” position as pilots seem to have a way of mismanaging the fuel on board. To our amazement, only one of those nine accidents involved the classic “air in one

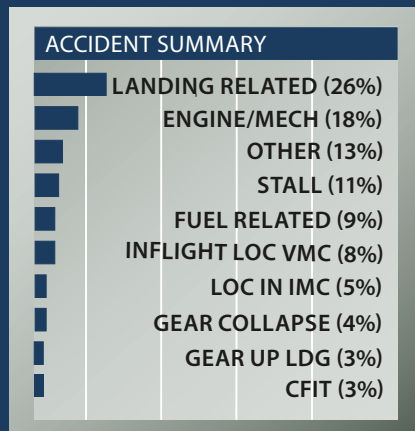
tank, plenty of fuel in the other” scenario so often observed after the dust of the forced landing clears.

Instead, all of the others involved engine stoppage due to water in the fuel. In at least two of the accidents it was clear that rainwater had gotten into the tanks because the flush-type fuel caps did not provide a complete seal. Having looked at dozens of water-in-the-fuel accidents due to aging flush-type fuel caps, we hypothesize that most of the other accidents had the same cause.

We are not fans of flush-type fuel caps. We recommend that M20J owners that have them replace them with umbrella-style caps, if possible. If not, inspect them for condition and seal regularly and be hyperalert for water contamination if the airplane has been parked outside during rain.

We noted what we consider to be a relatively high percentage of accidents due to either stall or other type of inflight loss of control—24. Most of the stall accidents were shortly after takeoff or go-around in high or hot conditions with the airplane fairly heavy. Uphill runways and/or intersection takeoffs on warm days are not friends to Mooney pilots.

We were surprised to see so many inflight LOC events, VFR and IFR. We do not think that the handling of the M20J is unusually demanding, but it obviously requires that a pilot take regular recurrent training in maneuvering in all regimes of flight.



With the 1991 introduction of the MSE, the maximum takeoff weight was increased by 160 pounds, from 2740 to 2900 pounds. The increase can be retrofitted (primarily a paperwork change and airspeed indicator exchange) back to some 1989 models, from serial number 24-1686 on.

PERFORMANCE, COMFORT

Performance is the bottom line for most Mooney owners. At 60 to 65 percent, true airspeeds average 150 to 155 knots and endurance with reserves at 4.5 hours or better. Some owners report 160- to 165-knot airspeeds and, while some airplanes definitely are faster than others, we're skeptical of these claims. Plan on 150 to 155 knots on about 10 GPH.

Typically equipped 201s can haul three 170-pounders plus about 40 pounds of baggage. With partial fuel loads—say 50 gallons—the Mooney still offers good range with seats filled. The 201 has outstanding altitude performance for a low-power, normally aspirated single, thanks to its comparatively high aspect ratio and efficient wing. Its performance is good enough to make cruising at 14,000 to 15,000 feet a practical matter, with oxygen of course. Service ceiling is 18,600 to 18,800 feet, depending on the version and if light, a 201 can go there.

The J-model isn't a rough-field airplane, although it will handle short runways admirably well. The gear doors almost brush the ground and the prop has less than 10 inches of clearance. Well-manicured turf runways are no problem; rutted gravel will beat up the doors, as will muddy surfaces.

Mooneys in general have a reputation for being cramped, but are in fact nearly as wide as a Bonanza. It's the shape of the cabin section that makes them feel snug.

The small frontal area of the airplane means that the seating position is rather sports-car-like, with feet stretched out in front. This is in contrast to, say, a typical Cessna, which is more like sitting in a kitchen chair. There is definitely lots of legroom: Pilots shorter than 5 feet 9 or so may have to use a booster cushion to reach the pedals. For folks with bad backs, the Mooney can be an irritant and it's not easy to ingress and egress gracefully.



The 201's low profile isn't great for rough-field operations.

The M20J is a relatively noisy, vibey airplane, some examples being worse than others. Cracks in cowls, baffling and cowl flaps aren't unusual. Good headsets, an intercom, a thicker windshield and sound insulation help with the noise. So does prop balancing.

The baggage bay is of adequate size and is approved for up to 120 pounds. Most owners don't mind the location of the hatch, which requires you to lift baggage over the sill rather than place it in. The baggage door doubles as an emergency exit for rear seat passengers (although some owners say it's too small or too hard to reach). The earlier models have fixed rear seat backs, which occasionally causes loading problems for really bulky items. The baggage door isn't all that large so muscling golf clubs into the airplane isn't easy. There are mods for fold-down rear seats to address this.

HANDLING

Control pressures in the 201 are higher than in other airplanes of similar size and power, thanks to the push-pull tubes rather than cables used to actuate primary flight controls. The result is direct, fast and linear response. The stiff roll feel is due to the tubes bearing against rub blocks that help carry the aerodynamic loads without binding.

Rudder is the lightest control in the three axes, but it also is the least powerful, although there's plenty of rudder to handle crosswinds. We've landed 201s with 20 knots across the runway, with control authority to spare. Pitch changes with con-

figuration and power changes are significant. A go-around or missed approach with full flaps requires anticipation and generous use of trim.

In landing configuration, application of power results in a strong pitch up. One trick of note is that the flap and trim motors run at the same speed, which means that the pitch change with flap extension can be nicely balanced by running the trim in the opposite direction at the same time.

Stalls in a well-rigged 201 with the stall strips properly located on the leading edge are brisk but not tricky. There can be a pronounced wing drop as the nose falls through, as it usually will. The airplane isn't approved for spins and they should be avoided. They're recoverable by conventional means but may require more altitude than the pilot is willing to give up or has available.

Mooneys have long had a reputation as floaters on landing. And they will float, if flown too fast on final, which most pilots tend to do. Nail the speed, however, and you can plant the airplane right where you want it, with minimum runway used.

Touch down too fast and force the airplane on, and you'll be in for a wild wheelbarrowing or skidding ride that could end in a prop strike or damaged gear. Similarly, takeoffs can be sporting and bouncy, too. The trick during takeoff is to set the trim properly, use flaps as recommended and apply a little back pressure. When the airplane wants to fly, don't try to hold it on the ground.

The biggest handling challenge occurs not in the air but on the ground. The turning radius is fairly large. This, coupled with the long wingspan and low seating position, creates taxiing and ground maneuvering problems for transitioning

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pilots. The limited nosewheel turning radius also creates maintenance problems. Untrained or careless ramp people towing Mooneys occasionally exceed the limits and damage steering horns, trusses and other nosegear components.

MAINTENANCE

Besides engine and steel-tube corrosion, Mooneys are plagued with fuel tank leaks and the 201 is no exception. Repairs are expensive and some owners have chronic problems. Others have none. Reseal quotes run from \$6000 to as much as \$12,000, if the tanks need major work involving hand scraping the old sealant through hard-to-access fuel bays.

Another recurring fuel system problem is water contamination caused by faulty fuel cap seals and/or corroded fillers. Advice: Change the cap O-rings at annual.

Leaking water also is responsible for another expensive problem. Poorly sealed (or deteriorated sealant in) windows or leaking storm windows allow water to seep into insulation, which leads to corrosion of the tubular cabin structure on the pilot's side. One shop said 50 percent of all 201s have the problem to some degree; another one said early (through 1982) Mooneys are the most affected.

Inspection and repair is expensive because the interior and insulation have to be removed. Even if an airplane has been repaired, replacing tubes is frequently required and the problem can recur if an improved type of insulation was not installed or if window leaks recur.

One repair operation recommends detailed inspection of all flight control elements, especially if an airplane has been repainted. Paint stripper can penetrate and corrode torque tubes, bell cranks and other elements of the system. Exhaust system elements, especially flame tubes and mufflers, also are repeat maintenance items, in part due to poor quality, according to some maintenance technicians.

Despite a variety of fixes, the cowl-mounted landing lights fail at an annoying rate, largely due to vibration. One owner says he went through 27 landing lights in nine years. One solution is to install an

HID lamp. These are expensive, but effective.

The ram air system also is prone to failure and regular inspection for deteriorating gaskets and proper operation is suggested. Some owners recommend sealing it and forgetting it. Using it adds a barely discernible bump in MAP. Finally, the next best thing to a warm, bird-free hangar are cockpit covers and cowl plugs. Birds like to nest in the tail cone and plugs in gaps will help. They don't seem to like the nose openings as much as in Cessnas or Pipers.

MODS, OWNER GROUPS

There are a couple good resources. The Mooney Flyer is at www.themooneyflyer.com. This is a monthly online magazine with other benefits. The Mooney Aircraft Pilots Association (MAPA at 830-315-8008 or on the web at www.mooneypilots.com) also has a magazine and other benefits, such as an insurance program.

There are a number of shops that specialize in Mooneys. Some mods are intended to make older Mooneys more like the 201, with sloping windshields, newer cowls, speed mods and the like. Others are mechanical and systems improvements.

Of particular note are Lake Aero Styling and LoPresti Aviation. Reach Lake Aero at 707-263-0412 and www.lasar.com and LoPresti Aviation at 772-562-4757 and www.loprestiaviation.com. Check out Precise Flight for speed brakes (www.preciseflight.com or 800-547-2558). Hartzell has prop upgrades; contact www.hartzellprop.com and 800-942-7767.

OWNER FEEDBACK

I have owned my 1979 M20J for 10 years and wish I had bought it 10 years earlier. This is my fifth airplane and the one that fits my needs better than any of the ones before. Oh sure, I would like to have something faster, roomier, with more useful load and maybe a turbo, but I do not think there is a normal-category airplane that does as many things as well as my Mooney.

Living on the West Coast, nearly all my trips involve crossing mountains. If weather is no factor, I fly at either 9500 or 10500 feet and flight plan for 150 knots at 10 GPH. With full tanks, that is a comfortable

700-NM range with IFR reserves. The extended cabin of the Mooney M20J is quite comfortable on long flights. With only two people aboard, the front seats can be pushed back to where even a tall person can't reach the rudder pedals. This creates a lot of space for the leg exercises I like to do on long flights. Ventilation is also good and the heater is excellent, even for back seat passengers.

Airplanes prior to 1980 had instrument panels that prevented deep avionics from being mounted near the top of the panel. Two years ago I designed a new panel that integrates an Aspen PFD with my existing (older) avionics. While not as flashy as a new glass panel, it provides an uncluttered layout and the same capability at a fraction of the cost. With ADS-B Out and a Stratus II on a rear window, an iPad mini fits nicely on the yoke and provides a moving map, weather and traffic.

Having flown heavy aircraft for over 30 years, I appreciate the solid feel and stability of a Mooney. I owned a Beechcraft 33 for many years and got used to the tail-wagging that's common to most Beech singles. I was pleased to find that the Mooney has none of that and is an excellent instrument platform.

Most Mooney parts are available from the factory through a network of Mooney Service Centers as well as from many third-party vendors. Numerous modifications are also available, but few are really needed. Deactivating the ram air system makes sense and the one-piece belly mod saves a couple of hours at each annual inspection. An LED landing light is also a good addition.

As for maintenance, there are certain things that Mooney owners have come to accept. The fuel tanks generally need to be resealed every 20 years. Sealing one leak at a time works for a while, but eventually the tanks need to be professionally stripped and resealed. Additionally, the landing gear "donuts" need to be replaced occasionally. For any Mooney parked outside, it is imperative that the side windows are properly sealed to prevent corrosion of the steel tubing.

It's said that the Lycoming engine in the 201 is one of the most proven and reliable engines in the industry. If flown regularly, one can expect it

to reach TBO without a top overhaul. According to some reports, three-blade props do not always get along with this engine. What they gain in climb performance, they lose in cruise speed and often have vibration issues. The two-blade McCauley the factory choose for the airplane has proven to be a good choice. Dynamic balancing can make a noticeable difference in taming vibration.

My only recurring problem has been the autopilot. My aircraft came from the factory with a Century 41—a full-featured autopilot designed for much larger aircraft. In addition to weighing nearly 30 pounds, it is difficult and expensive to repair. The King KFC-150 autopilots found in most 201s are a better match. Otherwise, the systems in a 201 are simple, reliable and fairly easy to work on. If something out of the ordinary needs to be repaired, however, I would recommend a Mooney service center. Not all shops have the same expertise in caring for Mooneys.

For the past several years, my annuals have averaged \$2000. There currently seems to be a lot of competition between insurance companies, which has resulted in some very good quotes. This year my insurance (based on \$110,000 hull and \$1 million liability) was \$975 through AOPA. Needless to say, I am very happy with my Mooney.

Charles Raines
Camarillo, CA

I sold my 1967 M20F in 2011 and purchased my second Mooney, N1165N, a 1983 M20J Missile 300. Rocket Engineering upgraded 40-something M20J aircraft by replacing the 200-HP IO-360 with a normally aspirated 300-HP IO-550 with a three-blade full-feathering prop. Think of it as a baby Mooney Ovation. The STC is no longer available; however, support from Rocket is outstanding. N1165N has extended-range Monroy fuel tanks with a capacity of 98 gallons and a useful load of 1067 pounds (a gross weight increase occurred as part of the STC). This mid-length Mooney is 200 pounds lighter than an Ovation and thus climbs faster.

When I took my wife (then girlfriend) for her first flight after the Rocket upgrade, she felt the accelera-



Charles Raines crosses the mountains while flight planning for 150 knots at 10 GPH in his 201, top photo. Precise Flight speedbrakes, bottom, help slow the Mooney's slippery airframe.

tion on the short takeoff roll and exclaimed "Hank wants to fly!" The aircraft is named Hank after its previous owner. It's a hot rod. I have excellent runway performance and can cruise all day at 180 knots true, mixture set rich of peak at 14.5 GPH at 8000 feet. My max speed run is 188 knots true, but that's burning close to 20 GPH rich down low. If you power back to 170 knots true, it burns 12.5 GPH. I can power back to stock J-model speeds and fuel burn, but I have become addicted to speed. The Missile has a heavy nose, drinks more fuel than a standard J and is generally priced between a standard J and an Ovation. I can fly 1000 statute miles in five hours or nearly 1500 statute miles in 10 hours.

My next upgrade will be a pressurized six or eight seater, but I don't think I'll ever sell the Missile.

Seth Meyers
via email

I have been flying for more than 40 years and have owned at least a doz-



en aircraft, including two Mooneys. Since I am 81 years old now, I expect this will be my last airplane and I wanted to get her as close to a new Mooney J as I could. Lake Aero Styling and Repair (LASAR) in Lakeport, California, does all my maintenance and we keep my Mooney at a "no deferred maintenance" level. My prior Mooney (16 years of ownership) was a 261 Trophy conversion by Mod Works.

This was a great airplane that I flew to the British West Indies, Alaska, Canada, many islands in the Bahamas, the Cayman Islands, Mexico (including many trips to Baja) and the Dominican Republic. This time I wanted a simpler aircraft for more local flights, although I have crossed the country in N335BB and made a

MOONEY 201

(continued from page 31)

few trips to Baja for whale watching. The J is fast enough at non-oxygen altitudes for me and is economical to operate.

This airplane has the electric speedbrakes which I much prefer to the vacuum ones I had in the 261. Both aircraft have backup electrical vacuum pumps because I strive for as much redundancy as prudent.

Over the years, I lost two vacuum pumps in IMC and in both cases switching on the electrical backup pump made the failures a non-event.

Bennett Bibel
South San Francisco, California

Pristine models like David Fatell's 1982 M20J, shown below, retail for around \$85,000 and up, based on avionics and the time on the engine.



I purchased a 1990 Mooney M20J three years ago. I previously owned a 2000 Cessna 182, a 2004 Cirrus SR22-G2 and a 2007 Cirrus SR22-G3T. I learned to fly in the Cessna and upgraded to the first Cirrus when I began traveling farther distances for business and often flew night IFR. I loved flying the Cirrus but found the operating costs to be unjustifiable once my travel was no longer related to business.

I wanted my next aircraft to be fast, fuel efficient, reliable and economical as I eased into retirement. I found a one-owner M20J that had been well loved and upgraded with a Garmin G500 PFD/MFD and WAAS navigator.

The Mooney uses half the fuel of my previous aircraft, costs less to insure (\$2000 per year), has much cheaper annuals (\$1000 to \$2000) and even though it is 26 years old, it has much better dispatch reliability than both factory-new Cirrus aircraft I owned. I give up 20 knots in speed, which is barely noticeable on my average flight missions. At the same time, I save at least \$50 per hour in fuel costs alone—even running ROP.

FEEDBACK WANTED

CESSNA 340



For the March 2017 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Cessna 340 cabin-class piston twin. We want to know what it's like to own these aircraft, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your airplane to appear in the magazine, send us any photographs (full-size, high-resolution please) you'd like to share to the email below. We welcome information on mods, operating expenses or any other comments. Send correspondence on the 340 by January 1, 2017, to:

Aviation Consumer
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Getting into the aircraft is obviously more difficult than in a Cirrus and takes some practice, but once inside, travel is comfortable. The flight controls are tight and responsive. Landing is easy once you learn to fly slow enough across the numbers.

My Mooney handles beautifully in IMC. If you are looking for a well-made, fast, safe and fun aircraft that many folks can actually afford to fly, I highly recommend the four-cylinder-powered M20J.

Andrew Miller
Grapevine, Texas

