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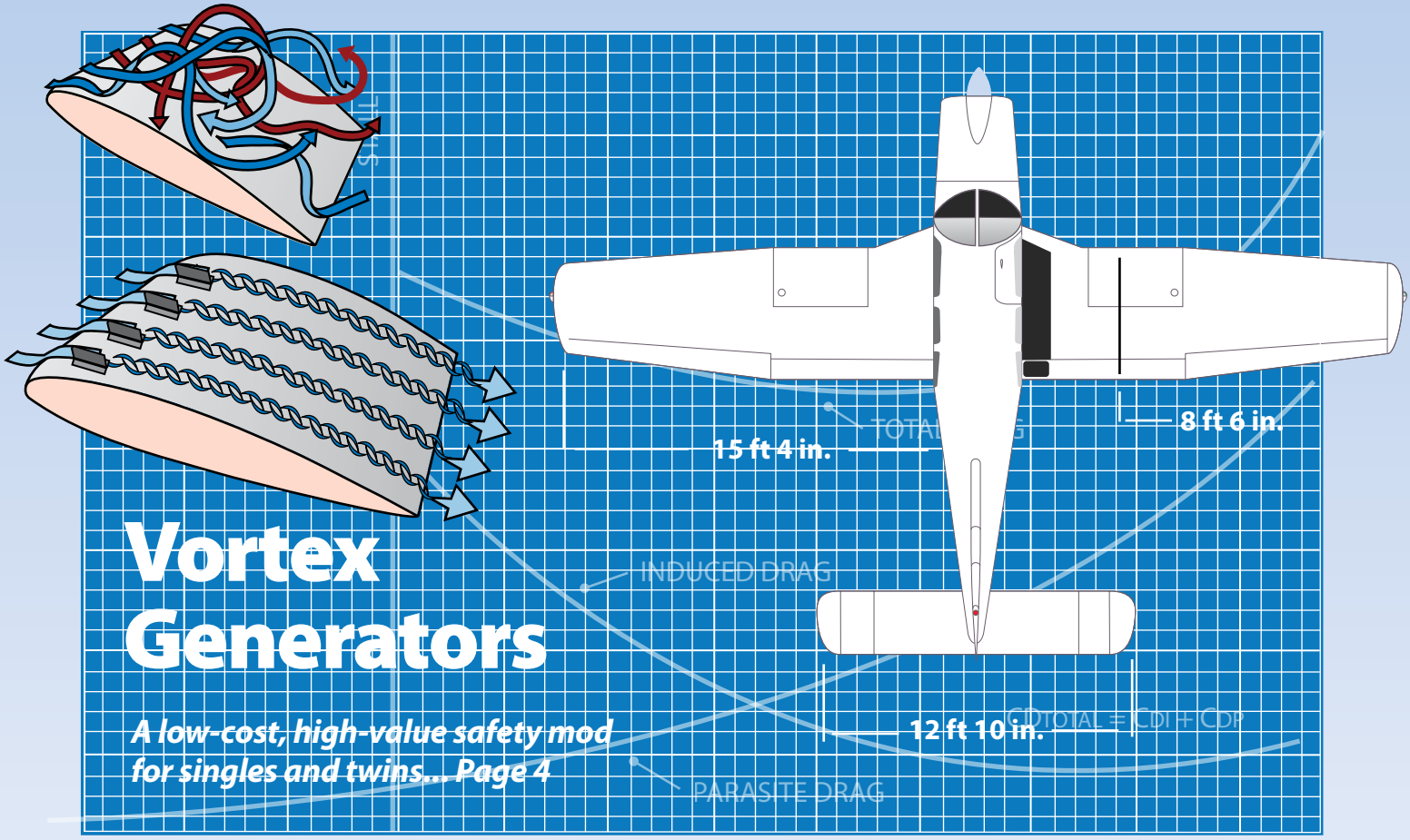
*The consumer resource for pilots and aircraft owners*

# The Aviation Consumer®




## Vortex Generators

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The Aviation Consumer

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## A GREAT IDEA MADE LESS GREAT

On page 11 of this issue, you'll find an in-depth review of Avidyne's new active traffic product being offered at a price that will finally make it affordable for Skyhawk and Archer drivers. Kudos to Avidyne and Ryan for making this happen. But this breakthrough is not quite as terrific as it might have been.

Specifically, it's saddled by what I call the $5000 surprise. And here it is: If you've seen the ads for the TAS600 selling for under $10,000 and you want to install one in, say, your older Mooney 231, you're out of luck, partner. (The fact that we own an older 231 is purely coincidental, by the way.) Because the 231 is certified for flight above 18,500 feet, it requires installation of the more expensive TAS610, which sells for $14,990. Still a better deal than the $20,000 Skywatch, but installing the cheaper version in an airplane certified above 18,500 feet may be tough to get past the FAA and even if you do, the software will lock out performance above that altitude.

In a word, this is ridiculous. I'll concede that at the higher altitudes, the closure rates are greater and a traffic system that sees further is a bonus. That logic is inarguable. But for a Part 91 aircraft, this equipment isn't required. It's purely elective, so accepting performance limitations should be a customer choice, not an FAA or Avidyne choice. The reality for me is that I was never a customer for a $20,000 traffic system. And at $15,000, I'm still not a customer, although I might be at $10,000. I'm sure I'm not alone. Conclusion: there will be fewer airplanes flying with these systems than there might have been and what should be a grand slam homer is, instead, a slide into third.

In requiring this kind of pointless certification hoop, the industry actively works against overall safety by limiting market choices through flyspeck, trumped up technical requirements that cost owners and manufacturers money and benefit no one. The industry and FAA continue to adhere to the idea that just because an owner has a higher performance airplane, he should therefore suffer market-will-bear pricing on equipment for that airplane.

On the positive side, we'll see a lot of modest singles with active traffic systems that wouldn't have had them otherwise. We'll also see a lot of owners who won't buy for the reasons I've stated. Go ahead, fire off an e-mail calling me a skinflint. But I'm sticking to my guns on this one.

## DESTINATION GROUND NAV

Judging by the mail we receive, many owners who buy a portable aviation GPS also use it for ground navigation. Garmin has that dual use pretty well figured out by offering excellent maps and ground nav software for such products as the GPSmap 296 and the new 396. As we've noted in our reviews, the ground nav software works beautifully and will get you to your destination without a hitch.

But there's a problem. Actually, two problems, both related to convenience, or lack thereof. Products such as the 296 and 396 are relatively large and bulky and although Garmin makes well-designed vehicle mounts for these navigators, you still have to move them from the airplane to the car and if you're driving a rental, you have to carry the bulky thing around.

Wouldn't it be better if Garmin or someone else had a pocket-sized ground navigator? It would and they do. We recently tried Garmin's pocket-sized Quest navigator—4 1/4 by 2 by 3/4 inches deep—and found it to be a terrific alternative to hauling around the bulky aviation portable. Two versions of the Quest are available. The original sells for about $370 from various Web sources while the Quest II retails for about $550. The Quest II has a complement of U.S. or European maps pre-loaded while the original version requires manual loading.

I have conceded to being cheap, but I still found it worth $370 to have a shirt-pocket, dedicated ground navigator rather than having the aviation unit do double duty. The Quest goes into the car or clips on the handlebars of a motorcycle without a second thought. It will run on external volts or about 20 hours on an internal rechargeable. The screen size is a tad small but the Quest does faultless address lookup and turn-by-turn navigation. For this price, it's a must-have gadget for me. —*Paul Bertorelli*

## Flashlights for Flying

I am not sure how to mildly complain. First, unless the FARs have changed, it is mandatory to carry a D-cell flashlight in your aircraft.

Second, in 60 years of using flashlights, I strongly recommend reversal of one of the cells. And buy high-quality batteries. Reversal prevents the all-too-common definition of a flashlight being an object you carry a pair of dead batteries in.

To use, untwist one end, dump the cells and reinstall in the correct order and then turn it on. And do consider replacement of the batteries as part of your annual.


Art Brothers
Via e-mail

*The requirement for D-cell lights is for Part 121 and Part 135 operations only. There's no specific flashlight requirement for Part 91 operations.*

One of my favorite flashlights is the Pelican VersaBright. I found it on the Web for under $20. It projects a pretty wide beam and I keep the green lens in it with the light clipped it to the visor. From there, it does a good job illuminating the cabin with green light for easy chart or unlighted gauge reading.

You could put it in a shirt pocket but I always found that it gave plenty of coverage from the visor. Getting the lens out requires twisting the bezel off, so I would keep a second light to check for ice.

Scott Macario
Via e-mail

Your article on flashlights for flying was informative. However, you were not thinking out of the box. You missed the greatest flashlight out there. It is made by Safelight Industries at www.safelight.com.

These are powered by one 9-volt battery. They are fully encased in a rubber housing with a one-button on/off. If you push it once, it goes bright, then dimmer, then flashes for an emergency with each push of the button. Also, one model even puts out the SOS signal. But the main feature of this light is that it never shuts off. Yes, that's correct. It goes into a very dim setting, which means you can always find it in the dark. They make an aviation model in blue, red and green. I have two in my airplane. Being that they are always on, they can be found quickly in the dark. They also have a neck strap. The lights will run up to 40 hours on the high setting and up to a year on the off setting, which really is not off so you can find it in the dark. I also have one in each of my vehicles and gave one to my wife for her purse, plus several in the house.

William A. Yendrzeski
Essex Junction, Vermont

## Mode-S or Not?

I have known that my old Narco transponder was going for some time now and transponders not being a particularly exciting item, I had not been looking forward to buying a replacement. When I saw the Garmin GPSMap 396 at OSH last summer, buying a new transponder suddenly got more exciting because I could upgrade to Garmin's Mode-S GTX330 and get traffic alerts on the 396.

Your article on traffic advisories in the November 2005 issue was like a bucket of cold water: What can the FAA be thinking in taking away the TIS? Anyway, ATC has let me know that I definitely need a new transponder now. So what would you advise? Get a basic cheap Mode-C or step up to the Mode-S and hope I can still get TIS for awhile?

Rick Baier
Via e-mail

*As reported in this issue, buying traffic gear is more complicated than it once was. If your budget allows, consider the new TAS600 active system from Avidyne reviewed on page 11. With a new Mode-C transponder—which it appears you need—plan on a $13,000 or so installation. If that's beyond your budget and you still need the transponder, we think the TIS system remains a good value and we believe TIS will be around for the foreseeable future. For owners who don't need a new transponder, the Mode-S upgrade just for TIS is less compelling, in our view.*

## Birdies Explained

Reference your review of VHF handhelds in the October 2005 issue, for those of us who are not electrical engineers, could you explain what "cross modulation" and "birdie" mean?.

David Breznick
Iron Mountain, Michigan

*Birdies are unwanted, internally gener-*

*(continued on page 32)*

### CORRECTIONS

In our January issue, several of the points we made about TrueFlight's EFB software were in error. You can in fact scroll maps from any of the pages and flightplans can be deleted both manually and from a menu option. Although no demo is available, an online video manual is at the correct URL of www.trueflight.org. In the December issue, we inadvertently omitted a photo credit on page 5. The photo was provided by www.flightprep.com.


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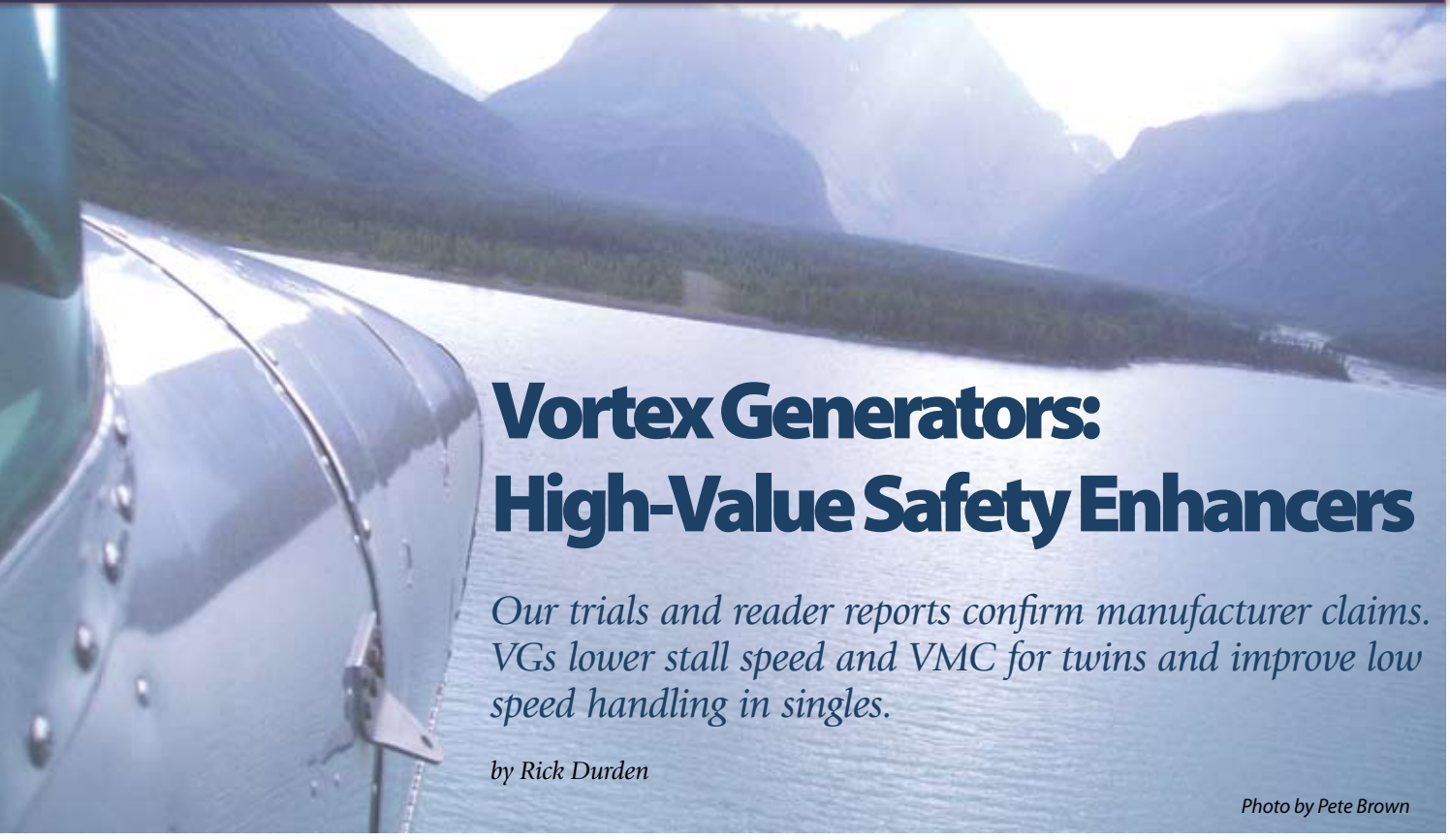


# Vortex Generators: High-Value Safety Enhancers

*Our trials and reader reports confirm manufacturer claims. VGs lower stall speed and VMC for twins and improve low speed handling in singles.*

*by Rick Durden*

*Photo by Pete Brown*

For any owner locked into the never-ending quest to make an airplane go faster, stall slower, handle better and maybe hum patriotic songs, there's no shortage of ads for performance enhancing modifications. Churning through the chaff seeking a kernel of value, we see fairly amazing claims for vortex generators—or VGs as the more hip are inclined to say. On ramps everywhere, we see airplanes with little angular bits of metal protruding from wing surfaces, the underside of horizontal stabilizers and vertical fins, like some weird form of aeronautical acne. We recently set out to find out if VGs really do deliver as the manufacturers claim. We flew a VG-equipped Cessna 310 and surveyed about 80 owners who have installed these mods.

Our findings: They generally deliver on their claims, sometimes dramatically. Owners can expect lower stall speeds and much better slow speed handling, plus reduced liftoff and approach speeds for singles and twins. The downside may be a cruise speed loss of a knot in slower airplanes and up to 3 knots in twins, although not all owners say they see slower cruise with VGs.

## THE HISTORY

Vortex generators appeared nearly 50 years ago, initially to channel localized areas of disturbed airflow over wings that lead to loss of control response. On the Boeing 707, in some flight regimes, the pilot could rotate the yoke 45 degrees with no roll response because airflow over the wing had separated, trapping the ailerons in disturbed air. Solution: Strategically placed metal dams at slight angles to the airflow forward of the mid-chord position generated

### CHECKLIST

- **Dollar for dollar, VGs are among the least expensive aircraft mods.**
- **Lowering $V_{mc}$ in twins and stall speed in both singles and twins is a safety enhancer.**
- **Kits are easily installed by owners on most airplanes.**
- **Cleaning and ice and snow removal from a VG-equipped wing can be a nuisance.**

*Top photo: "Here's where you want VGs...short final into Bold Strip, Eklutna Lake, Alaska," wrote Pete Brown, whose Cessna 170 is VG equipped.* Aviation Consumer *flew the VG-equipped Cessna 310, left, to verify performance claims.*

# How VGs Shape Airflow

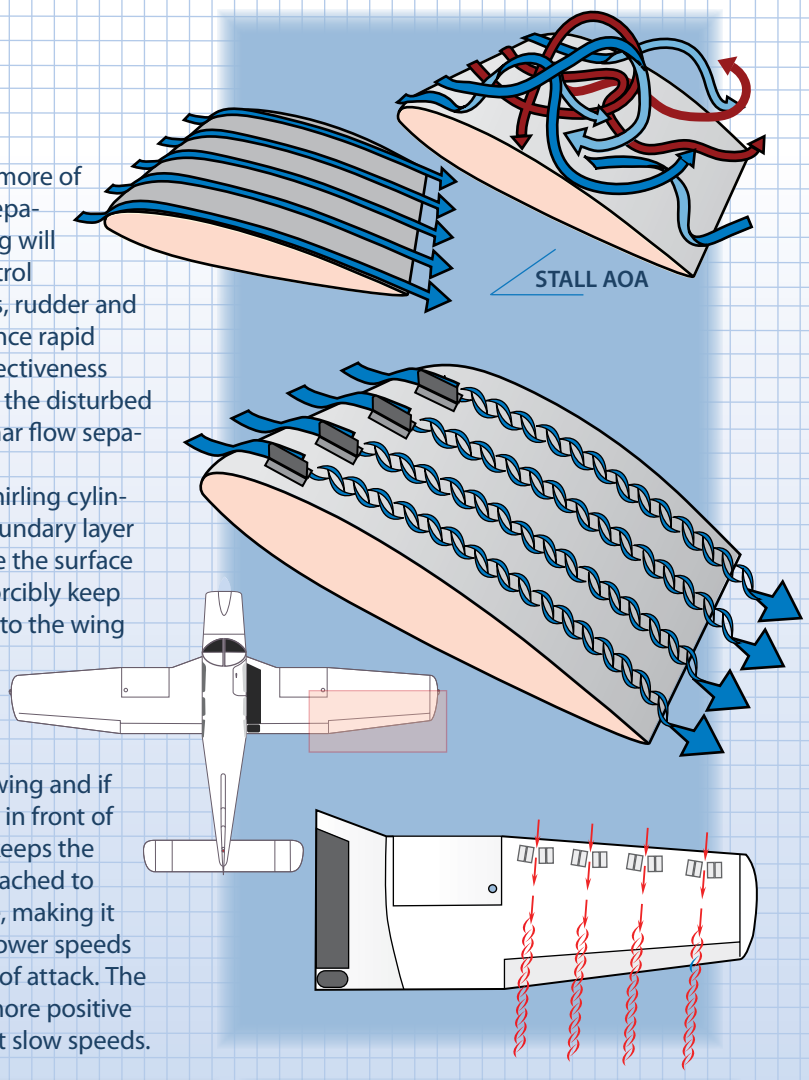
The boundary layer is generally defined as the layer of air from the surface of the wing, where the molecules don't move during flight, through a transition area, where the air molecules are slowed by friction generated by the airplane wing and are moving at a speed less than the speed of the airplane.

At a distance from the wing where the air flow isn't slowed by the passage of the wing, the boundary layer ends. Where the boundary layer is thin and adheres to the wing, with the airflow moving parallel to the wing surface, airflow is said to be laminar. That's the lowest drag airflow over the wing.

Moving aft chordwise or as the wing reaches progressively higher angles of attack, the boundary layer begins to separate from the wing surface. This separation creates turbulent flow, drag and a reduction in lift.

As the angle of attack of the wing is increased, more of the laminar flow separates, until the wing will no longer fly. Control surfaces— ailerons, rudder and elevator—experience rapid degradation of effectiveness when operating in the disturbed airflow aft of laminar flow separation.

By creating a whirling cylinder of air in the boundary layer immediately above the surface of the wing, VGs forcibly keep the layer attached to the wing even as a higher angle of attack is reached. This reduces the stall speed of the wing and if the VGs are placed in front of a control surface, keeps the boundary layer attached to the control surface, making it more effective at lower speeds and higher angles of attack. The pilot feels this as more positive control response at slow speeds.




| AIRCRAFT MODEL | MICRO AERODYNAMICS | BOUNDARY LAYER RESEARCH | RAM AIRCRAFT | BERYL D'SHANNON |
|---|---|---|---|---|
| 33 BONANZA | $1450 | • | • | $1500 |
| 35 BONANZA | $1450 | • | • | $1500 |
| BEECH DUKE | $1950 | $3950 | • | • |
| CESSNA 172 | $1450 | • | • | • |
| CESSNA 182 | $1450 | • | • | • |
| CESSNA 185 | $1450 | • | • | • |
| CESSNA 340 | $2950 | $2950 | $1650 | • |
| CESSNA 414 | $1950 | $2950 | $1650 | • |
| CESSNA 421 | $1950 | $2950 | $1650 | • |
| COMMANDER 112/114/115 | $1450 | • | • | • |
| PIPER NAVAJO | • | $3950 | • | • |
| SUPER CUB | $695 | • | • | • |
| SARATOGA | $1450 | • | • | • |
| SENECA | • | $3500 | • | • |

*Chart represents selected popular models and not all kits from all manufacturers are listed. Prices don't include installation. Some VG kits include gross weight increase, some don't and that may account for price differences. Check each manufacturer's Web site for details.*

| WEIGHT LBS | SPEED AT 50 FT KIAS | PRESS ALT FT | 0°C | |
|---|---|---|---|---|
| | | | GRND ROLL | TOTAL TO CLEAR 50 FT. OBS |
| 2950 | 60 | SL | 560 | 1300 |
| | | 1000 | 580 | 1335 |
| | | ⇨ 2000 | 600 | 1370 |
| | | 3000 | 625 | 1410 |
| | | ⇨ 4000 | 650 | 1450 |
| | | 5000 | 670 | 1485 |
| | | 6000 | 700 | 1530 |

For both singles and twins, one immediate benefit of VGs is flying slower approaches to achieve shorter landing rollouts. For a Cessna 182, for example, a 9-knot slower approach yields a 10 percent reduction in total landing distance. But actual results are often much better because without VGs, many pilots are uncomfortable flying at the minimum approach speed to achieve POH max short field performance. As a result, they land too fast and float. VGs make hitting the slow approach numbers more comfortable in most airplanes because they improve slow speed control response.

what are best described as horizontal tornadoes. These caused airflow to adhere to the wing, preventing boundary layer separation. (See the sidebar for more details.)

One might then say that VGs are engineering excuses for poor wing design—something tacked on to correct compromised design. In part, this is correct. Wing profiles for light GA aircraft were designed before computers could crunch the billions of bits needed to optimize an airfoil. The wings we fly are merely good, not perfect.

VGs, then, have become the add-on of choice to optimize the wing for the low-speed end of the envelope and to make the vertical stabilizer and rudder more effective, thus reducing $V_{mc}$. VGs have found their way into the light aircraft market through the efforts of a handful of companies.

The actual components of a VG kit vary by the type of airplane for which it's intended. Because of the expensive flight test requirements for obtaining STCs for VGs, not every airplane has a kit available. Manufacturers have understandably picked aircraft models whose potential market size justifies the expense of testing the VGs.

Further, in order to get the desired results, the kits can't be a one-size-fits-all for every type of airplane. While the majority of kit components consist of small angled metal channels we're used to seeing, some include strakes and other exotic devices. Some kits have gently curved triangles placed on the wing to create a larger vortex that acts as a stall fence to slow the propagation of the stall outward along the wing.

Because VGs protrude through only about 80 percent of the boundary layer, they don't appear to be affected by inflight icing. Further, they're usually installed far enough aft so that rime ice doesn't build on them, either. Clear ice, with its propensity to run back, may get into the VGs, but we've heard no reports from owners complaining about icing-related problems with VGs.

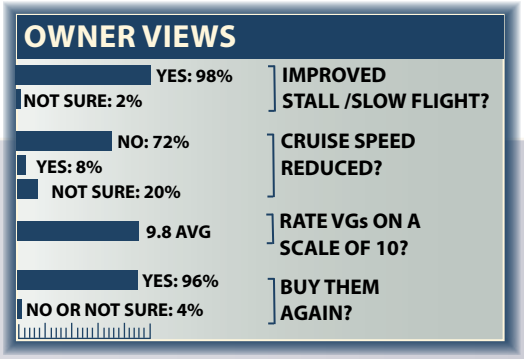
## MAJOR PLAYERS

For light GA, the development of the VG industry has enough plot and character twists to satisfy any soap opera lover. In recent years, however, the market has shaken out to two major players and two lesser players. The company with the greatest number of STCs for VGs is MicroAerodynamics, followed closely by Boundary Layer Research.

RAM Aircraft, the folks who do the popular big-engine mods for twin Cessnas, has some VG STCs and Beech Bonanza specialist Beryl D'Shannon has kits aimed chiefly at those aircraft.

While BLR doesn't post prices on its Website and is in the process of revamping both the site and prices, feedback from readers and calls to BLR indicate that where BLR and MicroAerodynamics have VGs for the same type of airplane, pricing is competitive, as are performance claims. Kits for most singles are under $1500, with those for the smallest, two-place airplanes as low as $700. Prices for twins start at around $1600 and range to just under $3000. Prices vary depending on whether there's a takeoff gross weight increase.

Because takeoff weight certification has to do with stall speed, decreasing stall speed may allow an increase in that weight with the installation of VGs. Usually, landing weight increases require more rigorous testing




# OWNER SURVEY: FEW COMPLAINTS

We queried both *Aviation Consumer* readers and subscribers to our online publication, www.avweb.com, about experiences with vortex generators. We corresponded with about 80 owners of airplanes ranging from J-3 Cubs to heavy piston twins. With few exceptions, owners are satisfied with their VG installations, some gushingly so.

We asked owners to comment on observed cruise speed reductions, if any, stall and $V_{mc}$ speed reductions and handling characteristics in slow flight and during stalls.

All of the owners reported stall speed reductions, confirming manufacturer claims. Stall speed reduction varies but most owners reported at least 5-knot reductions. Owners of single-engine airplanes reported post-modification stall behavior as a "shudder and bob" or "a mush," rather than a sharp break, yaw or roll. Those who commented on the subject reported improved low-speed handling, with ailerons being crisper at low speed.

A Musketeer owner told us—as did several other owners of light singles—that the airplane's takeoff characteristics were noticeably different with VGs installed, with a quicker, crisper rotation at takeoff.

Cessna 206 owner William Bartram told us VGs didn't change the stall behavior noticeably but that slow-speed handling dramatically improved and that he could reduce his over-the-fence speed by 10 MPH.

A number of Cardinal owners, fixed and retractable gear, reported stall speed reductions in excess of 7 knots with full control authority deep into the stall. Several owners of singles and twins said that with the increased control authority at low speeds, they felt comfortable in stronger crosswinds. Wrote Scott Sedam: "The Commander has a reputation as being difficult in crosswind landings due to lack of rudder authority…installation of the VGs made a major difference."

For single-engine owners, VG impacts on cruise speed proved nebulous. Some said they'd lost a knot or two, others noticed no difference. In any case, there was no persistent pattern of complaints about slower cruise

of the landing gear and structure, so only a few VG STCs increase allowable landing weight.

The VG kit contains everything you need to install it, except a ladder, according to one owner comment. Readers enthused about the quality of the kits, clarity of the instructions and ease of installation for both major companies. Many owners we corresponded with said they were able to install the kits themselves, under the supervision of a mechanic, minimizing the cost.

Peel-and-stick templates are laid on defined locations on the airframe. The skin is roughed up at the appropriate locations and each VG is glued in place with the adhesive provided. Strakes, if involved, are bolted or riveted into position. On most airplanes, the face of the airspeed indicator must be replaced because of the changes in stall speed and Vmc.

The manufacturers of VGs locate them slightly differently, with BLR VGs further aft than Micro's. We found no evidence that this subtle difference had any effect on the resulting performance. We suspect that there are those who feel passionately about such positioning issues and that there are dark little bars where the argument rages over glasses of beer. Readers reported time to install the kits ranged from a low of three hours for singles to about 12 hours for sophisticated twins.

speed. One owner who regularly flies two VG-modified Barons and an unmodified third said that the VG equipped airplanes had better roll control, were more comfortable to fly on final and that he could safely take those into shorter airports than the unmodified airplane.

All owners said that the kits were easy to install and the directions were clear, especially those from MicroAerodynamics. Kits include extra VGs should one come off, but they rarely seemed to be needed. One owner said that it had been four years and he'd yet to have to replace a VG.

We did get comments about cut hands when washing airplanes and the need for care when putting on wing covers but Alaska owner Pete Brown, whose Cessna 170 is pictured at left, said wing covers were no problem to install.


*MicroAerodynamic's kit for a Baron, top, contains several dozen pieces. For precise location of each VG, adhesive-backed templates are provided. Each VG, inset, is bonded with adhesive, as shown in the bottom photo, a Commander.*

## WHAT TO EXPECT

The initial marketing of VGs was to the owners of multi-engine airplanes. VGs promise to reduce Vmc, thus making the airplane's handling more forgiving and making it more likely that a pilot not up on his skills will keep the airplane upright.

Nonetheless, we still think it's imperative that pilots train frequently for engine-out situations. VGs simply aren't a substitute for proficiency.

To be sure, VGs do reduce Vmc anywhere from 5 to 12 knots. We sampled the performance of an Aztec D and a Cessna 310R with MicroAerodynamics VGs installed. At gross weight, our tests closely matched the performance claimed by Micro. For the Aztec, Vmc was down from 68 knots to 61 knots and was still above the clean stall speed.

In the 310R, clean stall speed had dropped to 76 knots, Vso was 68 knots. The reduced Vmc published by Micro is 71 knots, well below the clean stall speed. We chose not to perform a single-engine stall in the 310R as part of our Vmc trial, but stopped it when we were well into the stall buffet at about 77 knots, finding the airplane still easily controllable in yaw.

Our view is that it doesn't matter whether a hamfisted pilot coping with an engine out loses control because of the stall or a Vmc roll. Because of the installation of VGs on the wing and the vertical stabilizer, aileron and rudder effectiveness is noticeably improved at low speeds and in the stall.

The airplanes no longer handle as they did when they left the factory. Controls are more effective, not only reducing Vmc, but giving better roll control at and in the stall, reducing the likelihood that a pilot will lose control of the airplane.

Following engine failure, if a pilot flies the airplane at the single-engine best-rate-of-climb speed, VGs mean that the airplane is operating further away from its Vmc, thus the pilot has more room for error in handling the engine out. Another benefit of VGs is that takeoff roll is reduced because

the liftoff speed, usually a given speed above Vmc, drops due to the lowered Vmc. Beca use of this, the accelerate-stop distance is reduced, too. This means that more runways can be used safely by a given twin and it increases the margin of safety for any twin on any runway, if the airplane is flown as the STC requires.

Finally, depending on the kit, the installation of VGs may allow an increase in max takeoff weight, ramp weight and zero-fuel weight or some combination of these. For airplanes such as the Cessna 340A, with a tiny useful load when its numerous fuel tanks are filled, a VG-provided gross weight increase makes them nearly standard equipment on these models. But caution is indicated: If you take advantage of the increased takeoff weight, you've got to burn off enough fuel to be at or below max landing weight before you return to earth.

In single-engine airplanes, the advantages of VGs are primarily reduced stall speeds, with a side benefit of noticeably improved control response at low speed. VGs improve aileron response near and at the stall, making it less likely that a pilot who inadvertently stalls a VG-equipped airplane will lose control.

Our flights and reader feedback indicate that the stall of a VG-equipped airplane tends to be more docile than it was pre-VG. Where stall behavior was already good, say in the Cessna 206, VGs didn't negatively affect it. However, there's no magic bullet. Once the airplane is stalled, no matter how docile it may be, it's going to descend and the pilot must act accordingly.

For singles, and to a lesser extent, for twins, VGs function as inexpensive and lightweight STOL kits. This is a big deal for bush operators flying Super Cubs and Huskies which, with tweaked engines, can break ground in under 100 feet in still air. Further, they can safely fly approaches slower than a non-VG-equipped airplane can, and this can radically shorten landing rolls.

Stall handling behavior is also likely to improve with VGs. For airplanes such as the Cub and Champ, with no camber on the tail surfaces,

*continued on page 32*



# An EFB Odyssey: HP 's TC1100 and NavAir

*One owner's trek through the EFB jungle reveals three winners: a tablet PC, NavAir software and a pocket printer for printing plates on the fly.*

*by Ken Sutton*

Because I owned a Commodore-64 when Michael Dell was still in grade school, I consider myself an innovator rather than an adopter when it comes to cutting-edge computer technology. So I've been following *Aviation Consumer*'s reporting on electronic flight bags with more than idle interest.

As *Aviation Consumer* has pointed out, finding the ideal EFB solution is not easy and for many owners, it may be a long, expensive quest. What follows is a report on my experience.

In my view, the ideal EFB combines flight planning, a moving map with terrain, enroute charts, approach plates, airport information, NEXRAD, METARs, TAFs, lightning strikes, winds aloft and satellite imagery, all in a sunlight-viewable screen.

## WAY BACK

I began this quest in what now seems like ages ago, with Control Vision's excellent Anywhere Map product, which was initially limited to PDAs. The components included an iPAQ PDA, a glareshield GPS receiver, a

*HP TC1100, left, is a capable tablet but slightly too large. Sony U-70, below, is too small, albeit easy to mount.*

satellite phone, mounts and wiring harnesses. The satphone mounted with suction cups to a side window where I found a location that worked reliably to make connections in my Cessna 310. This proved far from ideal, as I learned on a trip through the Northwest.

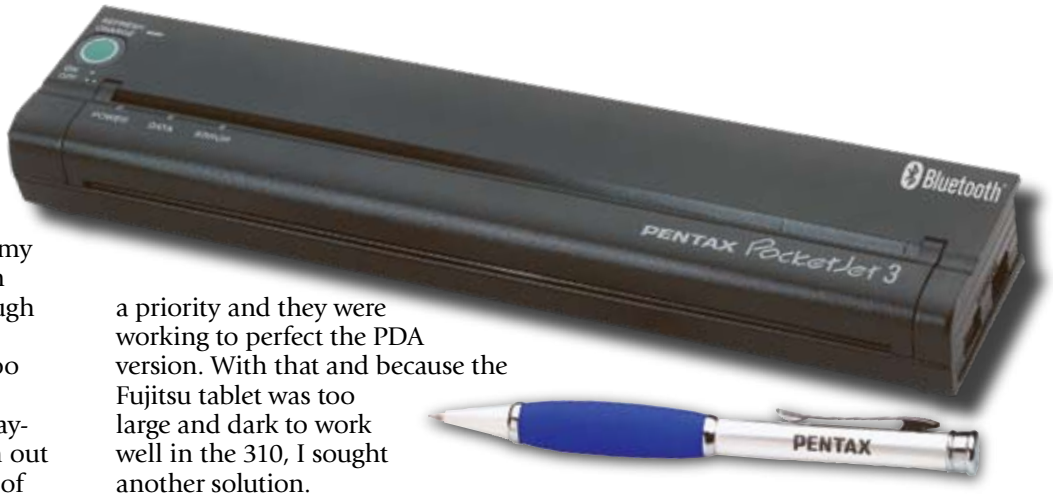
For my tastes, the PDA was too small, although it was fine as a moving map and even for displaying weather. But when I'd zoom out too far, the PDA would run out of memory and lockup. Additionally, trying to display an approach chart was clumsy, involving too many steps and allowing only a portion of the chart to be readable. Fortunately, I printed all the charts I needed so I had paper readily at hand.

The solution to this was simple. Pentax (www.pentaxtech.com) shipped one of their PocketJet-II printers—$350 to $450, depending on model—to my hotel in Seattle. I carried a notebook PC and connecting the printer was a breeze. The PocketJet is a tiny thermal printer that uses special paper from Pentax, but don't cringe at the thought of crinkly thermal faxes. The PocketJet paper is far better than that, if not the brilliant white high-rag stock you'd use in the office.

The bad news is that Control Vision's replication of NOS charts was in such low resolution that the printed copies were barely legible. Control Vision assured me they planned to fix this eventually. Further, I wasn't happy with the awkward satellite phone, either, so Control Vision suggested that I convert my set-up to their EFB package and to XM-based data from WxWorx. To their credit, they offered to exchange my gear with new for the difference in price, which seemed generous.

The new set-up included an XM receiver and software to run on a Windows XP computer. I purchased a Fujitsu tablet PC, which I had no means of mounting in the 310. I assumed I could use this set-up on my lap. The result was a disaster.

Control Vision's EFB software wouldn't run to my level of satisfaction. It would often lock up and didn't work well with the XM hardware. Finally, after hours of remedial work, a technician at Control Vision told me that the EFB software wasn't a priority and they were working to perfect the PDA version. With that and because the Fujitsu tablet was too large and dark to work well in the 310, I sought another solution.




## JEPPESEN NEXT

My next stop was Jeppesen, whose charts I had used for my entire flying career. Jepp offered two products that seemed interesting: FliteStar, their flight planning program and JeppView/FliteDeck for charts, both of which would run on a PC.

FliteStar is a terrific planner which includes DUATs link capability and Jepp's own proprietary weather. This is a tremendous complement to onboard weather because detailed planning/weather charts can be printed immediately before departure.

JeppView is really nothing more than a database of approach charts. Jepp provides pre-drilled paper for its binders which allows printing on both sides—if you have a duplex printer—to obtain a total of four printed approach charts per 8 1/2 by 11-inch sheet. Pentax says many corporate pilots use the PocketJet for printing Jepp charts on the fly and it does so in high resolution. The Pocket-Jet has a rechargeable battery-pack and Bluetooth capability, so it's quite practical in the cockpit.

FliteDeck is nearly a perfect moving map program, with good resolution and a host of features that allow easy display of almost any data on a big, easy-to-read display. But, FliteDeck has a failing. As *Aviation Consumer* reported in its January 2006 issue, Jeppesen offers no XM-based weather capability. I contacted Jeppesen about this huge hole in their product line, but never reached anyone who could assure me it would be addressed. Jepp has terrific tech support, but the lack of live weather is a shortcoming, in my view.

## LET'S TRY SONY

What to do? PDAs were out so the answer seemed to lie in an obscure product not offered in the U.S. It was the Sony U-70 palm computer, sold only in Japan but offered in the U.S. by a few importers, including AirGator/NavAir. They offer a full set-up including software and mounting for the U-70. Although it was thicker than I wanted and perhaps didn't have the battery power I'd need, the U-70 looked better than the Fujitsu.

I talked to AirGator's owner, Amir Tirosh, who was direct and helpful and suggested that I'd soon abandon Jeppesen FliteDeck for his offerings. He may be right. He has not only listened to my concerns and suggestions, but he has integrated them into a string of upgrades to his moving map program. (See the January 2006 issue of *Aviation Consumer* for a review.) AirGator seems to be working much harder than the rest when it comes to the details.

However, having flown with the U-70 for several months, I concluded

*Pentax PocketJet, top, can print out high-res approach plates, using Jepp-View. Plates are in black and white, lower photo.*

that the display, like the PDA, was too small. I wanted to view an entire Jepp approach plate and be able to clearly see it. What I needed was a tablet PC, sized similar to a Jepp plate.

When I began a panel makeover last year, it seemed natural to consider replacing the U-70 with something larger. The Fujitsu was too big and not bright enough for the cockpit and thus far, the best compromise I have found is the Hewlett Packard TC1100 at about $2500. Its form factor is smaller than nearly everything else out there, yet it has a bright and durable screen with tons of memory. Its detachable keyboard and integrated joystick mouse make it the ideal tablet/laptop multi-purpose computer.

AirGator helped me get the TC1100 to interface with my XM receiver and a glareshield-mounted GPS, via Bluetooth, eliminating the wires that would make this set-up otherwise unworkable. AirGator seems to be leading the way in new technology and their ongoing support is nothing short of fabulous, in my experience.

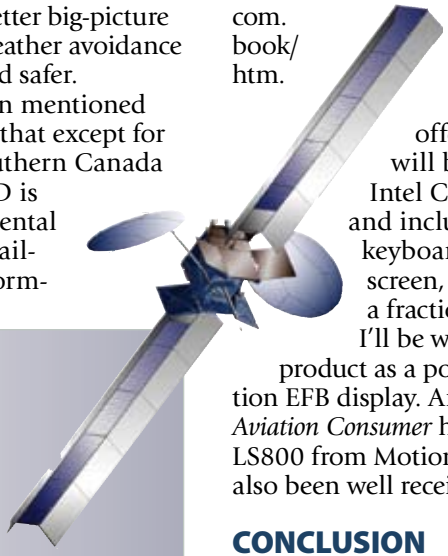
With the TC1100 running on ship's power and connected wirelessly to a GPS and an XM receiver, I returned last month from a 30-hour trip that took me through Western Canada and Alaska. On the fly, I connected my PocketJet to print out approach charts from JeppView when my itinerary changed. I used the TC1100 to plan my flights using FliteStar and Jepp Weather. Enroute, I use a combination of FliteDeck and NavAir map programs and use NavAir exclusively to display XM weather.

## HOW DOES IT WORK?

Displaying XM-based weather, especially NEXRAD, has been a huge enhancement to the utility of my airplane. I've flown trips that I otherwise would have scrubbed because I now have an in-flight view of the weather. Having flown with advanced weather detection displays for the airlines for many years, I find WxWorx better than what I use in airline flying. It provides a better big-picture view, which makes weather avoidance at a distance easier and safer.

One thing not often mentioned regarding WxWorx is that except for a bit of overlap in southern Canada and Mexico, NEXRAD is limited to the Continental U.S., with nothing available for Alaska, so Stormscope and/or onboard radar is still an asset in those areas. What would I like to have to improve the set-up? How about a single suite of software to do all of this? (I know AirGator is working on this.) I still wish Jepp would integrate WxWorx into their moving map, which ought to represent a huge business opportunity. I also wish the form factor of the TC1100 was smaller. Although the picture suggests the TC1100 gets in the way of the throttle quadrant, it doesn't. A slightly smaller tablet would be more convenient.

Since I use the computer for flight planning in the hotel, I need a detachable keyboard such as the TC1100 has. A touch screen like the U-70 would be nice, too. AirGator will be offering just such a machine later this year. It's called a Dialogue Flybook and can be seen here at www.dialogue.com.tw/english-flybook/htm. The new models offered by AirGator will be powered by an Intel Centrino processor and include an integrated keyboard and a touchscreen, all in a form factor a fraction of the TC1100's. I'll be watching this product as a possible fifth-generation EFB display. And, of course, as *Aviation Consumer* has reported, the LS800 from Motion Computing has also been well received.



## CONCLUSION

Finding the optimum EFB and display for moving map, weather and charts is still a work in progress. Panel-mounted displays and PDAs aren't very attractive compared to the advantages of a tablet PC's flexibility, in my view. On the other hand, a tablet PC's size is awkward, the display might not be sunlight readable and, incredible as it seems, at this writing, no one makes integrated software to seamlessly perform all the cockpit tasks pilots should expect of these machines. For me, the perfect EFB is a continuing odyssey. I'll let you know when I find it.

*Ken Sutton was an airline pilot for the original Piedmont Airlines and then US Airways. He is currently a senior partner at a private economic forecasting company.*

## When XM is MIA

For as wildly successful as it has been, WxWorx's XM-based datalink has encountered two nagging problems, one related to technology and another to customer service. We've heard complaints about both.

The customer service beef relates to ongoing confusion about the difference between XM Radio and WxWorx. The former simply provides the datalink, the latter does the weather products. They are separate companies. Unfortunately, XM Radio is more focused on its five million entertainment subscribers rather than the handful of data customers.

As a result, when some owners have called the XM technical service line for assistance with datalink, the tech has been clueless about aviation products. To remedy this, XM now has a dedicated call center for datalink issues. The number is 800-985-9200.

The second issue relates to anti-theft software built into XM chips. If the receiver isn't used for a certain period—and XM's Roderick MacKenzie wouldn't say exactly how long that is—the receiver reverts to inactive status and must be refreshed. Do that by logging onto to www.xmradio.com/refresh, then type in your receiver's ident code, then turn on the receiver.

MacKinzie told us software improvements have addressed problems some receivers had in going inactive too frequently, but he says XM sees no other way of protecting itself against theft of service. So if you have XM Radio, use it frequently.

# Avidyne TAS600: Beats Skywatch in Value

*The Avidyne/Ryan merger has dropped the price of active traffic systems to $10,000. Flexible display options sweeten the deal.*

*by Larry Anglisano*

One of the hazards of covering cutting-edge avionics is that what's hot one month, might very well be obsolete the next. That's not quite the case with the traffic alerting gear we covered in the November 2005 issue of *Aviation Consumer,* but the market has definitely shifted in just a couple of months with Avidyne's merger with Ryan International.

As we noted in the November report, real-time, active traffic alerting equipment is the best choice for pilots who are paranoid about swapping paint with another aircraft. It's also so expensive that many owners simply won't consider it. And at $20,000 or more for an installed system, we don't blame them.

But Avidyne and Ryan have just introduced an active traffic system that fills the price point wasteland between inexpensive portable or Mode-S-based TIS systems and high-dollar boxes based on expensive TCAS technology. We predict they'll find plenty of buyers, given the number of owners who ask us about these systems.

Avidyne and Ryan are a natural pair, in our view. Avidyne is a well-regarded veteran of the cockpit display wars and Ryan has been plugging away at traffic systems, carving a respectable share in what is by no means an easy market in which to sell. The new product is called the TAS600 and it's being marketed in a three-tier approach, with a price point for every buyer.

## MARKET SAVVY

In our view, the introduction of the TAS600 series represents more of a marketing breakthrough than fresh new technology in active traffic equipment. All of the traffic systems now offered in the Avidyne line represent trickle-down technology from Ryan that's well proven. The new Avidyne products are comprised mostly of technology carried from the previous Ryan line—they simply have new nomenclature, new pricing and the Avidyne name. Hardware remains largely the same, except for traffic range capabilities, which, as we'll see, is proportional to price. But price is the major development here.

The Ryan/Avidyne merger created the Safety Systems Group, a new division within Avidyne that remains based at the previous Ryan factory in Columbus, Ohio. Traffic system product support and marketing will also reside there. In-depth technical


*Avidyne's TAS600 is a single, remote-mounted box with two antennas, upper photo. It will play on a wide range of displays, including Avidyne/Ryan's 3ATI, right.*

### CHECKLIST

- The TAS series breaks the $20,000 barrier for active traffic systems.
- At an economy price, the TAS600 provides the functional equivalent of TCAS-1.
- Display flexibility is impressive. TAS plays on nearly everything.
- Due to color and typography, numerical data tags are difficult to read.



*Traffic displays use standard symbology, as shown on the FlightMax EX500, above. Relative altitude data inside black boxes can be difficult to read, lower photo.*

support of the new combined product line of Avidyne FlightMax MFDs and Ryan traffic equipment remains an unknown, but both companies have good track records. We hope to see a seamless interface between the two product lines, if not an improvement in the way Avidyne handles its orders to dealers, an area Ryan has perfected, in our experience. Although owners don't see this aspect of the business, engineering support for shops doing the installation work is critical. Without it, the work is delayed and the customer *does* see that.

One immediate result of the merger is what Avidyne is calling the MHAS6000, for Multi-Hazard Avoidance system. The Avidyne traffic products on the widest variety of displays already, but now Avidyne is offering its own complete system to compete with the Honeywell Bendix/King IHAS line. Avidyne's version is driven by a 7.2-pound single remote processor that measures 3.1 by 7.25 by 11.675 inches and is compact enough to secure to most airframes. It plays well with many displays through ARINC and RS232. The box is sold sans display; you pick the display you want or use one you already have.

## NEW LINEUP

There are three products in the Avidyne traffic line, all of which use active surveillance, meaning they interrogate other transponder-equipped aircraft. They all use the familiar Ryan top-and-bottom mounted antenna array, they all track up to 50 traffic targets and can display nine of the most critical. All of them also use voice annunciation; what Avidyne calls heads-up audible positioning. This means the box audibly calls relative range, bearing and altitude of conflicting traffic, with N-number traffic tags and target transponder squawk when available.

These are feature-rich traffic products that go well beyond early generation passive boxes and competing TAS systems that simply announce "traffic, traffic" to warn of potential conflicts. Interestingly, each of the three traffic systems is directly marketed and technically focused toward a specific class of aircraft, priced appropriately for each class.

Avidyne scaled back the price and performance of Ryan's flagship 9900BX product to suit a broader range of budgets without sacrificing any of the useful features found in this box. The result is the TAS600 focused directly at modest single-engine piston aircraft. It has a 7-mile range, 18,500-foot service ceiling and ±3500 feet of vertical separation criteria.

Normally aspirated Mooneys, Cessna 182s, Arrows and the Beech Debonair would be typical target applications.

Despite hopeful claims from some owners, these modest airplanes don't come close to 200 knots in controlled flight, eliminating the need for a traffic system that can calculate 1200-knot closure rates at a range greater than 7 miles. And not many are likely to fly above 18,500 feet. At $9900, the entry-level TAS600 represents a good bargain for entry-level aircraft. No other active system comes close in overall value.

The TAS610 kicks the performance up a notch, with 12-nautical mile range, a 25,000-foot ceiling and ±3500 feet of vertical scan. Light twins, turbocharged singles and small helicopters are the target market for the TAS610. At $14,990, it might stretch the budget of some, but we still think it's priced appropriately for a Baron, twin Cessna and most high-flying piston twins and singles that routinely ply the teens, pushing 200 knots.

One sour note: Even if you want to install the lower-priced TAS600 in an aircraft certified to fly above 18,000 feet, you can't. For one thing, the shop probably won't get FAA field approval and second, the software will lock out operation above 18,500 feet. We're sure some owners will have heartburn over this, but this appears to be the only way the FAA would certify the system.

The flagship Avidyne TAS system is the TAS620, previously known as the 9900BX. With a 21-nautical mile range, ±9900 feet of vertical scan and a 55,000-foot ceiling, the TAS620 is obviously for high-end aircraft, from speedy jetprop singles and twins to bizjets and transport helicopters. At $20,990 it represents the same price and performance points covered by the L3 Skywatch system and basic TCAS.

## AIR AND GROUND

We recently flew a fresh installation of the TAS620 and EX500 in a Beechcraft. The system called a lot of traffic and accurately. Interestingly, the aircraft was also equipped with a Garmin GTX330 Mode-S transponder playing TIS traffic on a GNS430. As we expected, the active, real-time TAS620 showed the traffic in slightly different positions than the TIS,

### CONTACTS...

Avidyne Corp.
800-284-3963
www.avidyne.com

making us dance in our seats twice as often. If anything else, it showed that active traffic alerting is more accurate and reliable than TIS because the latter suffers from processing delays as ATC radar sweeps and updates. (We still think TIS is a good-value basic traffic system, however.)

The TAS620 and all the other TAS systems in the Avidyne line use a top and bottom antenna, making the overall installation an involved, costly affair. In the Bonanza we flew, old coaxial cable had to be replaced with low-loss cable to stifle any stray RF that might interfere with the traffic system. Some existing antennas needed to be relocated to accommodate the TAS620 antennas.

There's also an optional weight-on-wheels interface that allows the system to sense when the aircraft touches down, automatically suppressing nuisance traffic callouts while operating on the ground after rollout and during taxi. Some aircraft might need an airspeed pressure switch interface as well, sensing low airspeed instead of weight on wheels when that won't work in an airplane without resorting to complicated and costly relays.

Similarly, interface with the aircraft's retractable landing gear is also possible, to automatically change the system's sensitivity during descents and climbs. These types of optional interfaces can add a sizeable effort and cost to an installation, so be clear with the shop on the bottom line. A control-yoke-mounted traffic mute/redraw switching adds fingertip control to the system and more work and money to the invoice.

For playing the traffic alert audio, we suggest a modern audio system, such as the Garmin GMA340 or PSEngineering PMA8000. Both have switched inputs, providing the pilot with an option to switch the traffic callouts out of the headphones when appropriate. Our experience is that passengers become uneasy as the system is calling traffic in congested areas with the pilot nervously scanning for visual contact.

## DISPLAY OPTIONS

Avidyne and Ryan appear to have engineered this system right but what's most right about it is the number of displays it will play on. This can be a little confusing so keep in mind that the basic remote box will drive just about any screen display and which one you select—or what you already have—will impact the installation cost. For the TAS600 and up, you can use any of Avidyne's FlightMax displays, the Entegra PFD, the Garmin G1000, 400/500 series and MX-20 MFD and Bendix/King's KMD550/850 series. Even display technology from smaller players such as OP Technologies, Chelton's Sierra, Sagem and Meggit are supported, to name a few.

Also on the display option list are Ryan's own digital display and 3ATI display, pictured on page 11. The digital display is a small rectangular unit limited to numerical display. We don't think it's good choice so the more sophisticated displays are the way to go. All of the displays use standard traffic symbology, regardless of which TAS model is installed. What varies is the aforementioned range and vertical volume.

A note on the traffic display on the EX500: We think the traffic tag is difficult to see and we're not alone. A few users with less-than-perfect eyesight tell us that reading the traffic data inside the black boxes on the screen's base map is a struggle, mainly because of the size of the text. This might be more of an issue in a Beechcraft with the stack displaced toward the right of the panel, but we still think the graphic design can be improved.

Avidyne tells us that there's a TSO-specified size for the traffic tag and that the TAS600 and EX500 displays comply with it. We would like to see users given the option of increasing the size of the traffic tags through a set-up menu. While the TAS series annunciates traffic position, some owners will still want to see the numbers and this is, after all, the point of having that expensive display in the first place.

## REGULATORY NOTES

There's one caveat to what seems like the perfect and inexpensive traffic system and it relates to FAA certification issues. All of the TAS600 systems are TSO'd under the Traffic Advisory System TSO C147 and each application must fall within the specs of the system to be installed. For example, if you tried to install the low-price TAS600 in a King Air, you'd have a mismatch between the system's 18,500-foot ceiling limitations and the aircraft's certified and typical operating ceiling. The Avidyne flight manual supplement for each system is clear on this applicability.

This limitation not withstanding, we think the lower end of this product line will be a winner for owners who just can't afford or won't buy a $20,000 L-3 active Skywatch system. In functional usefulness, the TAS600 essentially does what the Skywatch system does, but for half the money. It's well designed and well supported by two established companies and we think that will be more than enough to assure its success.

*Larry Anglisano is* Aviation Consumer's *avionics editor.*

**AVIDYNE TAS PRICING**

**BASIC BOX PRICES**

| | |
|---|---|
| **TAS600 $9900** | • 7-mile range<br>• 18,500 ceiling<br>• 3500-foot vertical scan |
| **TAS610 $14,990** | • 12-mile range<br>• 25,000 ceiling<br>• 3500-foot vertical scan |
| **TAS620 $20,990** | • 12-mile range<br>• 18,500 ceiling<br>• 9900-foot vertical scan |

**DISPLAY OPTIONS AND PRICES**

*The TAS series is delivered with no display. Prices below represent the add-on costs for the listed displays.*

| | |
|---|---|
| RYAN DIGITAL | $1290 |
| RYAN 3ATI | $1950 |
| AVIDYNE EX500 | $1950 |
| GARMIN 430 | $1450 |
| GARMIN 530 | $14,995 |
| GARMIN MX20 | $695 |
| BENDIX/KING KMD550 | $7990 |
| BENDIX/KING KMD850 | $13,440 |
| SANDEL 3400 | $9950 |

# PALs for Pilots: Cockpit Friendly Lenses

*If presbyopia has set in, progressives are the lenses of choice for pilots. Younger, Signet and Varilux are among the top choices for pilots.*

*by Dr. Bob Glass*

It's 0400 Zulu. A dark night, but it's a VFR flight with clear skies and unrestricted visibility. You pull out the sectional to look up the ATIS and Class-D tower frequencies. You look twice. What's that say? Is it a 12…or is that a 3? Better turn on the cabin light, squint a bit more. Oh, boy. Where's that magnifier?

Has this ever happened to you? If you're over 40, if it hasn't, it will. That is, unless your AME catches it first. There's even a name for it: presbyopia.

Literally translated, it means "old eyes." But don't despair. When the name was coined about a hundred or so years ago, people didn't usually live to be over 40, so if you were lucky enough to be old, you got this condition.

Well, now we have the privilege of extended life expectancies. Forty is barely early mid-life, so the presbyopia club is ever-expanding. We now think of presbyopia as middle-age vision and more and more people are entering that age range than ever before.

For pilots, presbyopia can be a huge pain, but one that's easily addressable with corrective lenses. Because pilots operate in a unique environment requiring near vision—for chart reading—mid-vision for instrument scanning and distance vision for traffic and navigation, the right kind of corrective lenses matter. A lot.

These days, most pilots opt for progressive addition multifocal lenses or PALs, a technology that's come a long way during the past decade. But progressives vary widely in their suitability for cockpit use. Here's a guide on how to select them.

## EQUIPMENT FAILURE

So, why does the focusing mechanism fail in the first place? The answer is that we slowly lose our ability to focus from the time we are born. Like a complex auto-focus camera, the human eye has a lens located directly behind the pupil, surrounded by a radial-shaped muscle called the ciliary body. The muscle is innervated by a complex of nerve connections between the brain, the pupil and the other eye.

When looking far away—beyond 20 feet—the lens is in a neutral position; no focusing is required. As the eyes look at objects closer than 20 feet, focusing becomes necessary; the closer the object, the greater the focusing requirement.

You can actually quantify the amount of focusing demand at a given distance. For example, at 16 inches (40 centimeters), +2.50 diopters of power is required. For you mathematics buffs, by definition, +1.00 diopter takes infinite (beyond 20 feet, or 6 meters) light and focuses it at 1 meter. At 30 centimeters, +3.00 is required; at 20 cm., +4.00 and so on. You can see how, as you get closer, the power requirement increases significantly.

At birth, the eye can focus as close as 2 cm, but as we age, this distance decreases. However, most of us don't notice what's going on until it affects our lives, usually with difficulties reading normally. On one flight, you can read the minimums box on the plate, on the next you can't.

Why does all this happen? The crystalline lens, which does the focusing, becomes more sclerotic and hardens as we age. That's because the most unique tissue in the body, the lens itself, is about 30 percent protein, where all our other tissues are almost completely made of water. Proteins denature with time, so the lens gets harder. It's not the muscle weakening. It's the lens stiffening.

Eye exercises won't help, by the way, so don't waste your time and money on hocus-pocus schemes. This isn't a muscle problem, it's a lens problem. You can't make those poor muscles do any more than they already are. So, it's either off to the eye doc or the AME, who then sends you to the eye doc. I personally recommend an eye exam before your medical, just to avoid raising the profile with your AME.

## NOW WHAT?

There are several ways of dealing

with presbyopia. They are eyeglasses, contact lenses, corneal refractive surgery—monovision Lasik or conductive keratoplasty or CK—surgical reversal of presbyopia and accommodating intra-ocular lenses, a form of cataract surgery, which the FAA just approved at press time. Corneal surgery is done monovision, meaning one eye is for far vision and one for near. It requires, for FAA approval, a six-month period of eyeglasses along with the monovision, followed by a waiver with a medical flight test. Monovision or bifocal contacts aren't permitted by the FAA.

While still a point of intense debate, the FAA disallowed monovision contact lenses in the aftermath of the Delta Airlines Flight 554 crash at La Guardia Airport on October 19, 1996. The NTSB ruled that the probable cause of the crash was pilot error due to the inability of the captain to overcome misperception of the airplane's position on the visual portion of the approach "because of his use of monovision contact lenses."

So, simply put, eyeglasses remain the best, simplest choice for pilots. Think of these glasses as nothing more than a tool to help you see what you need to see, when you need to see it. Keep in mind that by using these lenses, you don't become "addicted." The glasses don't make your eyes get worse; they will continue to get worse whether you wear glasses or not.

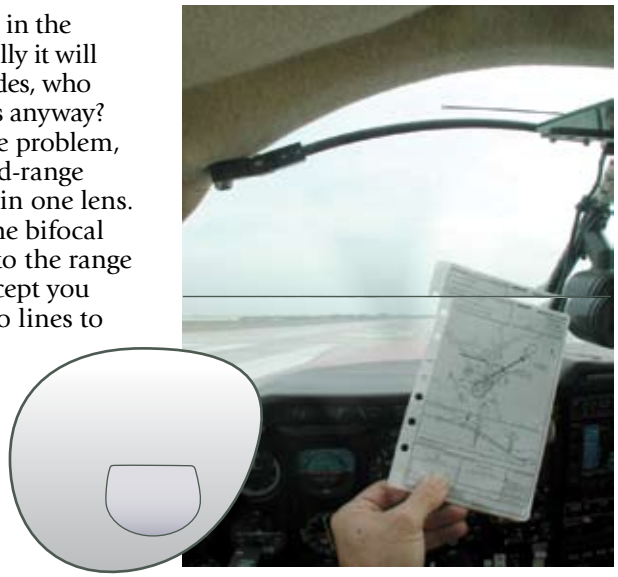
## LENS CHOICES

There are basically five options. They are single vision, lined bifocal, lined trifocal, blended and progressive. Single vision readers are fine for the computer or reading in bed because you can see clearly looking straight ahead at a single distance, usually 16 to 18 inches. But that won't work in the cockpit, because you need to see at a variety of distances and especially far away.

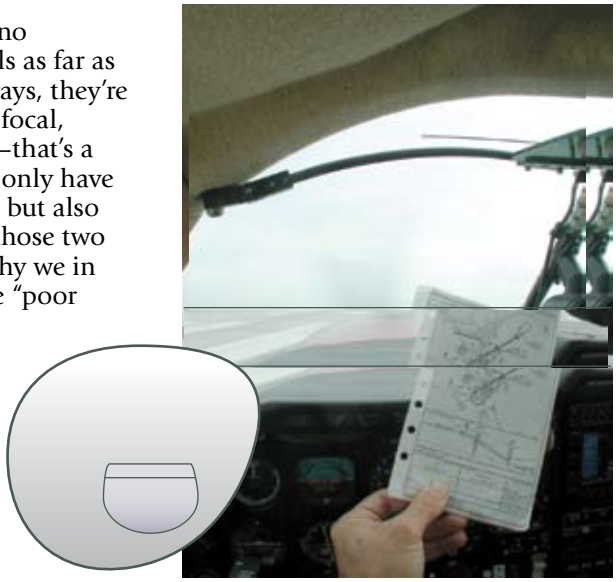
Bifocals are a better choice, since you can see near and far simultaneously. The downside is the slightly higher cost, the ugly line, which can get in the way, and range problems. What's a range problem? Every lens has a focal power. So if the bifocal is set for 16 inches, you can't see at 24 inches and vice versa.

A younger presbyope won't have as much trouble with this as an older one will—say, 43 versus 53 years old—because the lens power is less in the earlier stages. But, eventually it will become an issue. And besides, who wants a line in their glasses anyway?

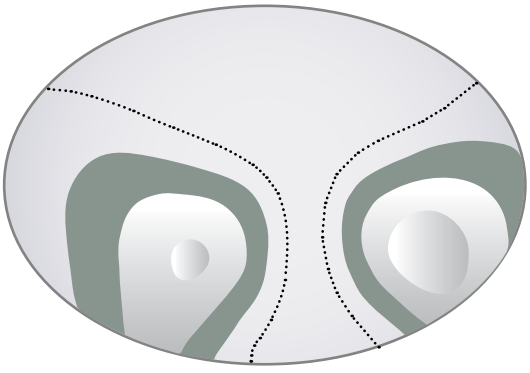
Trifocals solve the range problem, by providing distance, mid-range and near focal powers all in one lens. All of the advantages of the bifocal are there, plus a solution to the range issue. And that's great, except you now have not one, but two lines to deal with. The difference in price is minimal, but those lines…



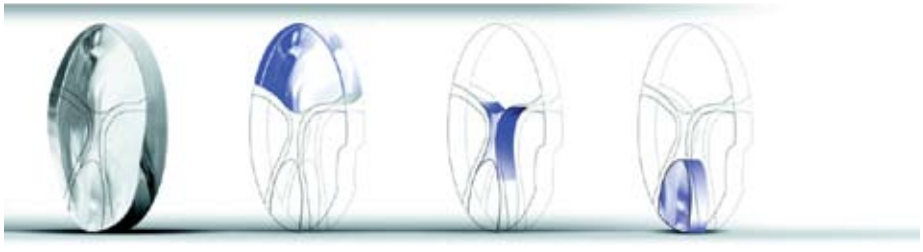
Which brings us to the no-line category of lenses. There are two types of no-line lenses, blended and progressive. Blended lenses are purely cosmetic; they are no better than regular bifocals as far as range goes and in some ways, they're worse. Imagine a lined bifocal, with the line rubbed out—that's a blended lens. So you not only have a lens with just two parts, but also a distorted area between those two parts. Which is exactly why we in the business call them the "poor man's progressive."



What's left is the progressive addition multifocal lens, or simply put, progressive. I like to compare the progressive lens to the Swiss Army knife. It does a little bit of everything, but it isn't

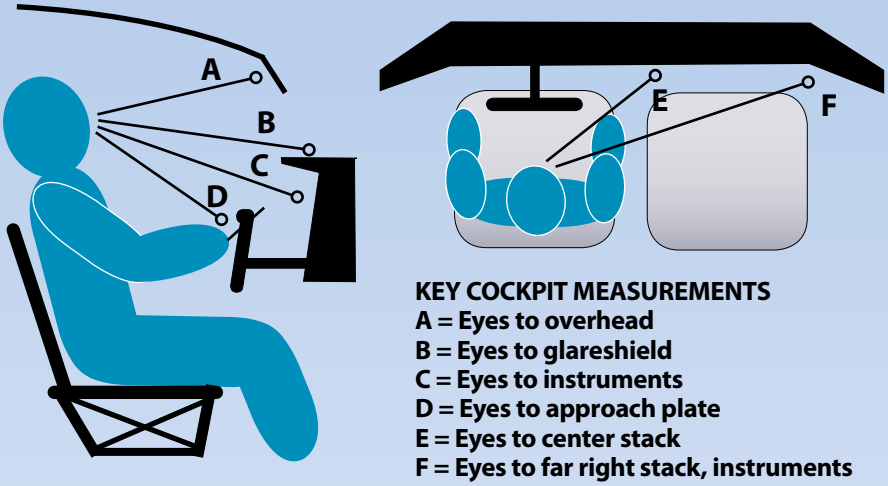


*Bifocals, top, and trifocals, center, are a traditional, inexpensive means of solving the range problem for close-vision correction. PALs, right, do the same job without the nuisance lines across the lens but at the expense of unwanted astigmatic zones to either side of the additive corridor found in the center of the lens.*

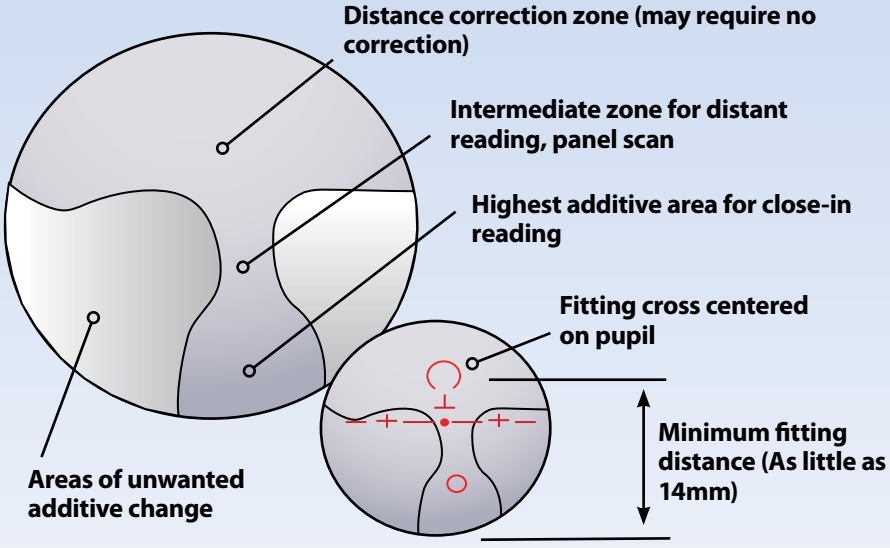


## PALS: GETTING THE FIT RIGHT

Because every pilot and cockpit is different, some pilots may need a specific set of PALs tailored only for flying. Even if that's not the case, to spec the correct lens, the cockpit dimensions shown here should be made available to the optometrist during fitting.




**KEY COCKPIT MEASUREMENTS**
**A = Eyes to overhead**
**B = Eyes to glareshield**
**C = Eyes to instruments**
**D = Eyes to approach plate**
**E = Eyes to center stack**
**F = Eyes to far right stack, instruments**




## TOP LENS PICKS FOR PILOTS

Of the nearly three dozen progressive designs I know about, here are my top five picks of brands. The less the distance from the frame bottom to the pupil, the smaller and lighter the lenses will be, offering more choices in frames.

- **YOUNGER IMAGE**—Widest array of material options of all PALs; can go to 18mm from pupil to frame bottom.
- **SIGNET ARMORLITE KODAK PRECISE**—Good balance between all viewing portions down to 20mm.
- **VARILUX COMFORT**—Reduced swimming effect in periphery with 18 to 20mm from frame bottom available.
- **SOLA ONE**—Advanced design based on newest technology, also down to 18mm.
- **VISION EASE OUTLOOK**—A 99 percent adaptation rate for this brand, also with 18mm capability.

specific for just one task such as, say, a carving knife. A single-vision pair of computer glasses would be like that carving knife—perfect for the computer, but useless for much else.

The progressive lens has all the advantages of the trifocal, without any lines. Well over 50 percent of all multifocal lenses made in the U.S. are of the progressive design. It provides excellent vision at far, near and mid-range, without the distracting line. It's by far the closest replacement to out-of-service zoom focus you can get, making it the best choice for pilots.

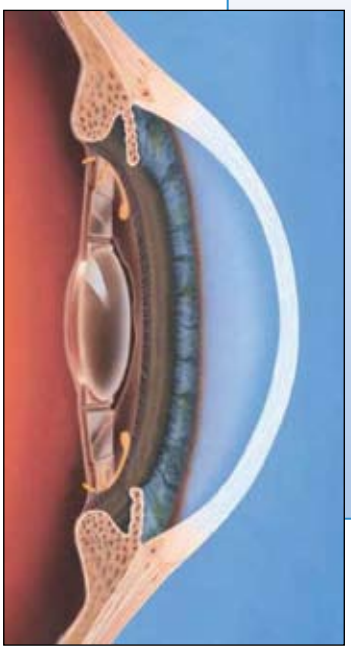
### HOW THEY WORK

Progressive lenses have been around, in one form or another, since 1959. They have evolved over the years through many generations. But one thing they all have in common is that they have a distance portion at the top—which may be no power at all, for you eagle eyes—with a progressively stronger corridor that increases as you look down, to provide for near focus. What this means is that you can see the approach chart through the lowest part of the lens and your gauges through the middle corridor. And when approach calls traffic, just look straight ahead through the upper portion of the lens. No need to be distracted by taking the glasses on and off.

As depicted in the diagram, the lens design allows for unrestricted horizontal gaze in the distance, with a corridor for the middle ranges and a maximum power area at the bottom, usually set for 16 inches or so. As depicted in the diagram, the lens design allows for unrestricted horizontal gaze in the distance, with a corridor for the middle ranges and a maximum power area at the bottom, usually set for 16 inches or so. The transition between sections is seamless and smooth. But, this comes at a price. In order to make this transition continuous, there's a compromise in the lateral vision in the middle corridor and near zone. We call these lateral limitations unwanted astigmatism and unwanted distortion. Looking through these areas, you won't see clearly.

Not until the late 1980s were progressive lens designs beginning to deal effectively with peripheral limitations in the near-vision portion of the lens. There are an infinite

number of possibilities in these lens designs. The bottom line is to find ways to keep the unwanted astigmatism as far as possible away from the most commonly used parts of the lens. This profile can be illustrated by a contour plot, which shows the fingerprint of the specific lens design.



Each profile has pros and cons Some designs work best for midrange (computers), while some allow for more near area vision. There's no single best design and each manufacturer will claim that their product is better. However, it's critical for the provider of your eyewear to be familiar with all the lens design options and their specific properties, especially when it comes to flying. I feel that distance area considerations are especially important in the cockpit. More on that in a bit.

## PAL TYPE RATINGS

So, how many progressive designs are there and which is best for you? My last count was about 28 contemporary designs. There are about six newer designs that I prefer. Thanks to computer modeling and patient trials, these most current lens designs are easier to wear, providing maximal fields of view and clarity of vision.

Distance viewing area is a major consideration for flying, especially for those who never needed glasses until age 40. Distance areas range from 18 $mm^2$ to 56 $mm^2$. That's a lot of variation. Intermediate is second in importance, in my view, because that's for the instruments over to the transponder and radio/GPS stack. Intermediate areas in the mid-strength prescriptions range from 13 to 28 $mm^2$. Unfortunately, the lenses with the most intermediate area are not the same as the ones with the most distance area. And that, folks, is why there is no single best choice.

At the end of the day, a number of variables need to be considered to arrive at the right choice for cockpit use. These include the cockpit configuration, frame preference and prescription. To make it more complicated, there are lens materials and treatment choices. You have your pick of materials such as glass, plastic and polycarbonate. Lens extras include high index and anti-reflective, transitions (for plastic) and polarized, scratch-resistant and photochromic for glass.

My personal preference is plastic lenses with an anti-reflective coating such as your quality camera lens has. Glass lenses are just too heavy. I also prefer polarized lenses for daytime flying, although I am just a piston driver. You should know these don't work very well with tempered windows and with some avionics displays. I learned this the hard way in a King Air. I ended up having to use my clear glasses to see. So you Plexiglas window folks can use polarized— not so for the heavy metal crowd.

## FITTING CONSIDERATIONS

It's critical to look through the central portion of these lenses. A quick look at the contour plot/fitting cross diagram on page 16 will help. I suggest, if possible, superimposing the fitting cross on a contour plot of the lens you have in mind to show how important this really is.

It's all too easy to make an error in proper lens placement; if the center of the lens doesn't align with your pupil, you will be looking through distortion areas instead of seeing clearly through the corridor of clear vision. Since you can't see the marking in the lens used to make this alignment, you must have confidence that the optical professional doing the fitting is experienced.

At one time not so long ago it was common for patients to have trouble adjusting to PALs. But the good news, according to Dr. Bob Lee, clinical professor at the Southern California College of Optometry, recent studies have shown that success rates for progressives are as high as 98 percent. And the chief causes of non-adapting are measurement error, followed by lack of proper instruction and failure to properly troubleshoot problems through frame adjustment.

So, no quitters allowed. PALs sometimes require an adaptation period as a long as a week. Occasionally, they have to be re-made, either because of a prescription or measurement problem, a fabrication error or even because you need a different style of lens than was anticipated. Be patient. Also, the frames need to be adjusted periodically. Your eye-care provider should offer this service at no charge. Speak up if there are any difficulties. Odds of success are far better than they ever were.

## BUYING RECOMMENDATIONS

First, find an optometrist familiar both with progressive lenses and aviation. How? Ask your hangar buddies for a recommendation but

## MULTI-FOCUS IOLs GET FAA APPROVAL

As we go to press this month, the FAA has just approved two new optical technologies for pilots: multi-focus contact lens and multi-focus intraocular lens implants or IOLs.

Multi-focus contacts do the same job as PALs but, obviously, without requiring glasses. For pilots who wear contact lenses or wish to, the FAA's announcement is good news, for it opens up more options for anyone requiring distant vision correction and/or presbyopic correction.

Intraocular lenses are a surgical option that's been around for about 25 years. At one time, they were used exclusively in conjunction with cataract surgery but techniques have become refined to the point that IOLs are now elective.

A version of IOLs called Crystalens has been FDA approved since 2003. The device is inserted through a small incision behind the cornea. The Crystalens hinges on both sides so it essentially restores flexibility to the lens and allows the ciliary muscle to respond to focus requirements to close-in vision. Although it may not restore the accommodation you had as a teenager, IOLs are likely to greatly reduce dependency on glasses.

also check this Web site for a listing of aviation-savvy professionals: http://209.83.210.5/drlocator/search.asp. Second, use an optical dispenser that knows its stuff and will guarantee its work. Usually, that will be in the same place as the optometrist, but not always. I have a dispensary with more than 1800 frames, four opticians and my own in-house lab. Bigger is not always better, but it helps. A dispensary with an in-house lab is helpful, because they can give a quicker turnaround and if there's a problem, they can do it again just as quickly.

Don't try to find the cheap way out. Better quality lenses work better. But they cost more. You wouldn't use the cheapest headset (who needs the headache?) and you don't want inferior quality frames or lenses, either. Stick to the name brands.

Don't give up. Work with your eye doctor and optician to find the best solution for your needs. Remember, there is no "best" answer; the solution for you is the one that works for you. The sidebar on page 16 gives my specific recommendations for lens brands. Others may certainly do just as well but I've had consistently good results with those listed.

A word about frames: Until recently, there were significant limitations on the vertical dimension of the frame. We needed at least 21 mm between the pupil of the eye and the bottom of the frame. Now, with recent advances, we can accommodate as little as 14 mm. That means that smaller, cooler looking, more comfortable frames are fine for PALs. And unlike days gone by, frameless and drill-mount designs of lightweight titanium can be used for progressives.

I'm partial to titanium mountings;they're durable, hold their shape, can be bent and sat upon (not recommended) and still remain light. And I always recommend the smallest frame size that will work with your face and prescription. For sunglasses, I recommend a frame large enough to protect, but with a minimal wrap. The Terminator look is cool, but the distortion in a prescription lens is not going to make you smile.

*Dr. Bob Glass practices optometry in Costa Mesa, California. He owns a Piper Warrior.*



# FSI's Hypoxia Training

*This innovative simulator-based program shows what it's like to become utterly stupid in the cockpit from lack of oxygen. It's a worthy alternative to a chamber ride.*

*by Paul Bertorelli*

If pilots don't love acronyms, they at least learn to live with them, but here's one you probably haven't heard: MEGO. I found it penciled in the margin of a manuscript that had been reviewed by an editor I worked for in the distant past. MEGO means "my eyes glaze over" and a manuscript so labeled was deemed too boring to even merit further comment.

Articles about hypoxia often go MEGO one better, some substituting nicely for a sedative chased with a glass of wine. That's to say that pilots—especially those most exposed routinely to hypoxia—tend to downplay its hazards because they've never experienced it. Despite recent high-profile hypoxia-induced accidents—the Payne Stewart Learjet crash and the Helios Airline crash in Greece—only a tiny fraction of pilots have trained for hypoxia awareness. Bluntly, the risk is not taken seriously.

Flight Safety International has devised what I think is an innovative simulator-based program to address this shortfall. I recently sampled the three-hour course at FSI's Orlando Learning Center. Although I'd taken a chamber ride 10 years ago, FSI's program was a revelation.

*The reduced oxygen breathing apparatus, below, invokes potentially intense hypoxia.*

## LOTS OF $N_2$

To invoke genuine hypoxia in a simulator, FSI partnered with the Mayo Clinic to develop a hypoxia awareness trainer with something called a reduced oxygen breathing device. It essentially exposes the trainee to mixed gas breathing in which the ratio of nitrogen to oxygen simulates the lower oxygen partial pressure reduction of high altitude. Nitrogen content is ramped up to as much as 92 percent, from the 78 percent atmospheric ratio.

Reduced oxygen breathing was developed by Mayo as early as 1936, as part of its considerable experience in aerospace medicine. Digital technology now makes it possible to build an automated computer-monitored reduced breathing system that FSI has installed in six of its learning centers, according to FSI's Larry Schuman. He says the system will eventually be available in all of FSI's facilities. The one we flew was installed in a Level D Citation Bravo simulator.

The point of the training is to provide an alternative to a traditional altitude chamber session so that pilots can experience hypoxic symptoms in the environment they're most likely to encounter it: the cockpit. Further, it doesn't require a day or more, as some chamber rides do, and there are no post-training flight

restrictions. The training can be done as a standalone or in conjunction with other FSI sim programs. Cost is $950 for the three-hour course. That doesn't place it out of reach for the owner of a flight-level-capable piston airplane, but the target audience is turboprop and jet operators.

## CLASS AND SIM

Like traditional chamber rides, the training consists of classroom orientation and hands-on training with the equipment, although a simulator is involved rather than the chamber. FSI instructor's Johanna Rosser and Eric Dixon took me through the program. Anyone who has taken a chamber ride will be familiar with the theory. Rosser does a brisk review of high-altitude physiology, including the basic gas laws you would remember if you'd been awake in high school physics class. (If only you'd known you'd become a pilot…)

Unlike chamber training, the FSI course is relentlessly focused on learning, in detail, what your personal hypoxia symptoms are and then responding correctly *in the cockpit*. "Pilots are trained to pay attention to the airplane," Rosser says. "But here, we're teaching them to pay attention to their bodies."

Any pilot can list potential hypoxia symptoms, but can you list them all? There are at least 14 and Rosser says everyone experiences different combinations. Says Dixon, "I want to know this: What's my first symptom, not my strongest symptom." To find out, each pilot goes through two brief hypoxic sessions.

The first is a non-flight segment in which you're fitted with a medical oxygen mask and placed in the stationary sim. By increasing the nitrogen mix, the computer-controlled profile climbs rapidly to the oxygen saturation equivalent of 22,500 feet, where it will remain for up to seven minutes, followed by a rapid return to the surface.

During this profile, the pilot is asked to write down his evolving symptoms and to do serial subtraction problems. In the second session, the pilot flies the simulator with the mask in place and hypoxia is induced at some unknown point, mimicking insidious pressurization failure. Having learned his symptoms, the pilot is expected to respond automatically: Immediately don a mask with supplemental oxygen and begin an emergency descent. Worry about the pressurization failure later. During both sessions, $SPO_2$ is monitored by a medical-grade pulse oximeter.


*FSI's Rosser, right: "Pilots are trained to pay attention to the airplane. Here, we're teaching them to pay attention to their bodies." Mixed gas breathing is computer controlled and monitored, lower photo.*

During the symptoms phase, I found that the reduced breathing apparatus creates sharply more unpleasant hypoxic symptoms than I recall from my chamber ride. But I'm 10 years older, lighter and in better physical shape or my symptoms could have otherwise changed. And that's exactly the point of the training, according to Rosser and Dixon.

My first symptom—lightheadedness—appeared at an $SPO_2$ of 92 percent. By the mid-1980s, I was feeling dizzy and disoriented. After 3 1/2 minutes at 22,500 feet, my $SPO_2$ had sagged into the high 60s and my note page says "fell like crar," which was supposed to be "feel like crap." This response is far more distressing than I recall from my chamber ride. After three minutes, I desperately wanted out of the mask.

During the flight session, I initially jumped the gun with false symptoms. But Rosser cautioned me to take the time to recall the symptoms I'd learned in the first session. Five minutes into the flight, with my $SPO_2$ at 92 percent, I noticed the first definite symptoms: slight dizziness and shortness of breath. With Dixon in the right seat, we donned emergency oxygen and descended from 35,000 feet to breathable air at 10,000 feet. (That alone took four minutes.)

The takeaway? When definite symptoms appear, don the mask and descend. Everything else can wait. The second takeaway illuminates my skepticism toward pulse oximeters in the cockpit. Without correlating your symptoms with your $SPO_2$, these instruments don't deliver much value. Everyone's symptoms and $SPO_2$ are different. It's more practical to know your symptoms than to simply monitor $SPO_2$.

## CONCLUSION

In retrospect, the Stewart and Helios crashes should have been utterly avoidable. FSI has proven that training to recognize hypoxia and respond immediately is hardly brain surgery. I think anyone flying a pressurized airplane—especially a jet or turboprop—should consider FSI's course. Although it's expensive, it's not out of line for operators who do periodic sim training.

If this type of training gains a foothold, I'd like to see FSI develop a less expensive, tabletop version for mid-altitude piston drivers whose training budget doesn't include Level D sims. There's much to be gained by broadening this type of training.

### CONTACTS...

Flight Safety International
800-497-4023
www.flightsafety.com

# Soft Hangars

*They're quicker to erect than metal but not necessarily cheaper. If you're considering one, an open-ended sunshade is the way to go, but check local permit requirements before committing.*

*by Ben Barnard*

What is it about hangars? Most airports have a years-long list of owners wanting them, acres of open land to build them and plenty of suppliers willing to do the work. Yet hangar construction seems to be a rarity. Airport boards drag their feet on permitting or simply reject the idea outright.

In desperation, this has caused some hangar-starved owners to consider so-called soft hangars—tent-like structures with fabric pulled over metal frames. Obviously, they should be cheaper because they're quicker to erect than metal hangars and shouldn't require much site work or permitting, right? Not really.

Our investigation into soft hangars suggests that they aren't necessarily cheaper than metal hangars, although they can do with less site preparation. Costwise, the most economical approach is a sunshade-style hangar open at both ends. These will provide surprisingly good protection for an aircraft, even in wintry climates in exchange for no options on heating or secure storage.

To gain some sense of soft hangar economics and practicalities, we interviewed both the manufacturers of these products and owners and airports who have installed them. Worth noting is that as in some segments of the metal hangar trade, these companies don't build hangars as such, but shelters suitable for hangars. Most will custom build any size hangar the customer wants and they honor special requests of all kinds.

**CHECKLIST**

- Soft hangars are easy to erect and can be built as freestanding structures rather than blocks.
- Open-ended sunshade style hangars are the best, most economical choice.
- Whether open or closed, expect mold issues with the fabric in moist climates.

## SHELTER STRUCTURES

Shelter Structures, Inc. is based in Stuart, Florida and has been in business for about 20 years. They've sold hangars to private owners and FBOs throughout North America. If a structure requires a building permit, they can provide drawings signed by a structural engineer who is licensed in the contiguous 48 states.

Recently, the company won a contract to construct 36 sun shelters to cover training jets at air stations in Texas and Mississippi. These open-ended shelters are several thousand dollars cheaper than fully-enclosed hangars, a price point consistent with all of the manufacturers we spoke with.

*Chip Ottinger's Big Top hangar at Cross Keys, New Jersey, took about a day to erect. All-in cost, less paving, was $10,000.*

Shelter Structures' Bill Wolters told us that many owners shopping a fabric hangar against a steel one are "disappointed initially from the misconception that fabric buildings are cheap." Rather, he explained, fabric hangars are just as durable and offer the same capabilities as their rigid counterparts but at a commensurate cost for an enclosed structure. Shelter Structures offers free estimates for hangars, on a project-specific basis, and Wolters said a fully enclosed hangar, with a zippered door, large enough to accommodate a light twin would cost between $11,000 and $15,000. An open-ended sun shade would cost about $10,000.

Shelter Structures has recently completed a product-wide redesign that includes heavier galvanized steel support trusses and stronger fabric, a 20- or 28-ounce PVC (polyvinyl

chloride) industrial fabric with a thermoplastic fluoropolymer topcoat that resists UV exposure, is flame retardant and will slough off accumulated dust and dirt when it rains.

The material is slightly translucent so that no artificial lighting is needed during the day. The new fabric will last 20 years plus, while the old fabric was good for about 15 to 20 years. These structures are engineered to withstand winds of up to 90 MPH with the fabric on, 140 MPH with it removed. All structures are built to comply with local snow-load requirements.

Wolters said that smaller hangars can be assembled "like an erector set" by two people in an afternoon. Materials are delivered to the site and no special tools are required. The fabric is attached to the frame and tensioned with ratchets. Anchoring can be by auger stakes or the structure can be unanchored or even placed on wheels. Concrete floors or foundations, of course, raise the price considerably.

## FABRIC STRUCTURES-USA

Ken Stanley of Fabric Structures-USA told us his company has been manufacturing soft structures in Lake Worth, Florida since the 1970s. He likes to steer potential customers in the direction of a sunshade rather than a fully-enclosed hangar for several reasons. The first is price. He said that many people are put off by the $14,000 to $15,000 price tag for an enclosed hangar measuring 44 by 30 feet, the size of typical T-hangar. A sunshade of the same dimensions will cost under $10,000.

Second, in humid conditions, condensation forms on the inside of the fabric and unless you have a climate control system, you'll have to vent it regularly to prevent the accumulation of moisture. His candor on this issue gave us pause. If you need air conditioning or even a fan to maintain a suitable storage environment, you'll spend far more for a fabric structure than you would for a conventional sheet metal hangar. While ventilation may be cost-effective for industrial structures, its costs outweigh the benefits for a small hangar.

Fabric Structures-USA offers 18-, 24- and 28-ounce PVC fabric wrapped around hot-dipped galvanized steel trusses. The fabric is available in three opaque colors that will allow for natural lighting during the day. The 18-ounce fabric has an estimated life of 10 to 12 years while the heavier fabric will last for up to 20 years. Construction options are the same as those available with Shelter Structures and are generally accepted as the norm for soft structures: Save money if you do it yourself, spend more to have it done for you, including overall cost and any legal hoops you'll have to jump through. For a free estimate, visit the company's Web site at www.fabric-structors-usa.com and plug in the size hangar you're interested in.

We visited a small, family-operated turf airstrip in rural Florida that had a row of 20 Fabric Structures-USA sunshades erected 20 years ago. These so-called pull-throughs are open sunshades anchored in concrete with adjacent units sharing support columns. (Newer versions don't use the shared columns, however.) All of Fabric-USA's sunshades are free-standing so that they can be disassembled for repair or removal.

Concrete slabs were poured in the center of each unit to avoid mud bogs and tire ruts. Although the structures—which have been through at least two hurricanes recently—appeared to be in good shape, every shade had an accumulation of mildew, giving credence to Stanley's advice about moisture worries with enclosed hangars and even, apparently, open sunshades.

The owners told us other than a "tiny twister" bending some trusses, they've had no maintenance problems with their sunshades. The fabric—affixed by tiedowns and tensioned with a system of cables—remained unscathed. Most of their customers are ultralight owners because the sunshades, at $125 a month, are cheaper to rent than sheet-metal Ts. That rental fee has more than covered their initial investment.

We asked about security issues. The owners conceded that there have been instances of gas cans and radios being stolen from the open structures, despite daily Sheriff patrols and a gate that's locked at night. But overall, the sunshades worked so well that they commissioned 20 more from another soft shelter company, Big Top Manufacturing.

*Big Top's arch-style hangar has welded trusses made of S-bend tubing. It's anchored by rods and plates driven into the ground, top.*

## BIG TOP MANUFACTURING

Perry, Florida-based Big Top Manufacturing sells structures similar to the other companies, with translucent PVC fabric available between 18 and 28 ounces stretched over galvanized steel trusses. Big Top offers open-ended hangars for under $9000, with price increasing depending on size and options. The Big Top sunshades we saw in Florida were built to mirror those done by Fabric Structures-USA. The only difference between the two was that the trusses on the Fabric Structures were painted rather than galvanized. Both had mildew on the fabric.

John Eddowes, who operates a busy skydiving center in Cross Keys, New Jersey, erected two Big Top

*Manatee Airport, left, has two blocks of arch-type sunshade shelters. Newer designs don't use shared columns for the arches. In humid climates, mold is still a problem, lower photo.*

fabric hangars for maintenance bays and a private owner erected an open Big Top sunshade right next door. He told us it took about a day to erect each one and that the hangars were shipped with all the necessary parts and materials. He told us the instructions provided with the hangars were clear and complete. "It's so well put together that erecting it is pretty easy. The hardest part is pulling the fabric over the frame," he told us.

Any cautions? "They say no permit is necessary and that's right, technically," Eddowes said. "But by code, if you anchor them, you do need a permit." Eddowes planned to leave his hangars in place for only a short period of time in Cross Keys, after which they would be moved to another airport in New Jersey. His advice is get the permitting squared away before buying the hangar. Eddowes' hangars, each about 45 feet square and 19-feet high, cost $10,000, plus another $5000 for asphalt paving. Both are anchored with steel pins driven below the paving. Eddowes told us all three hangars have been through significant wind and snow storms with no physical damage, other than occasional retightening of tension cables.

As did Eddowes, G.W. Pridgon of Big Top stressed to us the issue of permitting, because portability is a selling point for soft hangars. Owners interested in soft hangars like that option, which is what sets them apart from fixed steel hangars that are comparable in price but usually have to be relinquished if an owner moves or the airport leasehold changes.

Speaking of which, public-use airports rarely sell land upon which to erect a hangar. The arrangement is usually a long-term leasehold with a monthly or yearly fee. These should be committed to a formal contract with a clear understanding that the fabric hangar you erect can be removed at your discretion.

## CONCLUSION

Here are some numbers to ponder: Hangars are more commonly rented rather than bought. Typical monthly T-hangar rents range from $100 to $600, depending on geographical location. Using $250 (including leasehold) a month as an average, 10 years worth of T-hangarage will cost $30,000.

Although long-term rentals are the norm, hangar purchase deals aren't unusual and T-hangars are usually built in project blocks at costs ranging from $10 to $25 per square foot, again, depending on the airport and the land arrangement. Pick the middle of that range and a typical 1000-square -foot T-hangar costs $15,000 to erect, with monthly leasehold fees on top of that. Our surveys reveal that some small hangars suitable for singles and light twins cost as much as $35,000. At the lower end of the scale, a $15,000 purchase to store a $100,000 airplane isn't a bad option, in our view. If it's available, that is.

An open-ended fabric shade

*continued on page 31*

FUTURE FILE

## ROBOTIC HANGARS

At the opposite end of the fabric hangar spectrum is a new concept in aircraft shelter being shopped by a company called Av Stak Systems, Inc.

As the name implies, Av Stak is proposing to build high-dollar, multi-story hangars with aircraft parked and retrieved by the same kind of robotic systems used in the automotive, manufacturing and retail industries for automatic inventory handling. A company called HK Systems, with expertise in this technology, is partnering with Av Stak.

Av Stak's Eric Whitted told us such hangars could be built in multiples of about 120 airplanes with monthly rental rates of $400 to $500 per aircraft, depending on density. On the plus side, the structures would be hurricane resistant and protected against fire by automatic sensing/extinguishing systems. On the other hand, owners wouldn't have the option of storing stuff in their hangars and would depend entirely on an operator to park and retrieve airplanes.

Whitted says the Florida Department of Transportation has asked for a proposal to build a small test project for the Av Stak system. For more information, contact 727-343-6890.

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# Cessna Cardinal RG

*Thirty years after emerging from the factory, these singles still look sleek and modern. Performance and market prices are respectable but to avoid headaches with the landing gear, shop for a later model.*

To some, the Cessna 177 Cardinal RG is the sleekest and most attractive piston single Cessna ever built. The Cardinal RG shares its fixed-gear sibling's strutless wing, rakish cowl and windshield, along with a seating position that lets the pilot see past the leading edge of the wing, while allowing all four occupants to ride in the shade.

Many say that it's also the best compromise for its class: faster than all but the Mooney, roomier than all but the Beech Sierra, better useful load than any and very hard to load out of CG.

Of course, it's also had its share of problems. The landing gear has been a major weak point, although owners point out that with good maintenance, the landing gear is no more problematic than any other aircraft. The fuel system also had early problems, which were fixed about halfway through the model life. And finding good maintenance is an issue. With a relatively small population, there are many more mechanics who claim to know the Cardinal RG than really do.

Cardinals—both fixed and retractable—have one more big advantage: an owner organization, Cardinal Flyers Online (CFO), that many say is the most active and supportive owner organization in general aviation.

## HISTORY

The Cardinal RG is basically the same airframe as the fixed-gear Cardinal. This may not have been a favor to the RG, since the fixed-gear model, introduced in 1968, had a number of well-publicized problems that took a couple of years to sort out. The lack of power in the original FG Cardinal (150 HP) was fixed with an upgrade to 180 HP. Reduced stabilator authority in the flare was fixed with leading-edge slots in the control surface. The RG, however, started and stayed with a fuel injected 200-HP Lycoming IO-360 engine and had the leading-edge slots in the stabilator from the get-go.

***Many say the Cardinal RG is the best compromise in its class. Faster than most, with a high useful load and hard to load out of CG.***

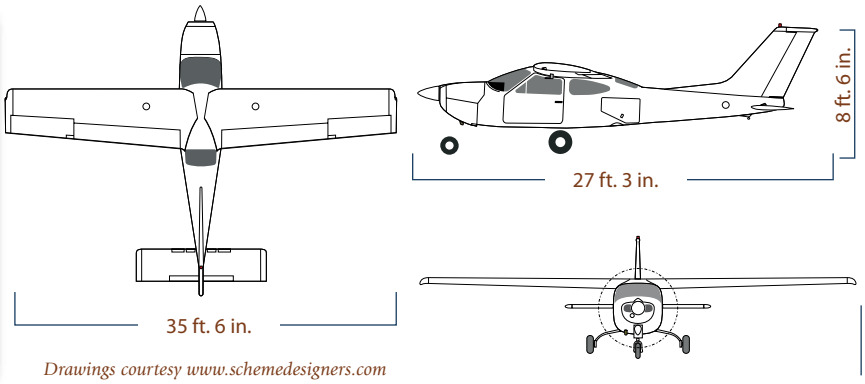
*With no clunky struts and the gear in the wells, Chris Thompson's 1977 Cardinal RG looks as sleek as anything flying. (Photo by Matt Lilienthal.)*

The larger engine gives the Cardinal RG a welcome boost in gross weight compared to the fixed-gear airplane (2800 vs. 2500 pounds), although empty weights are higher as well. The net gain in useful load is about 100 pounds.

The competition in 200-HP four-seat retractables at the time of the Cardinal RG's introduction in 1971 was fierce. Piper had been building its successful Arrow for four years, Mooney was well established with various flavors of the M20 and Beech had just started selling the Sierra. It was a lucrative market segment, attracting buyers wanting a high-performance single

# CESSNA 177 CARDINAL RG

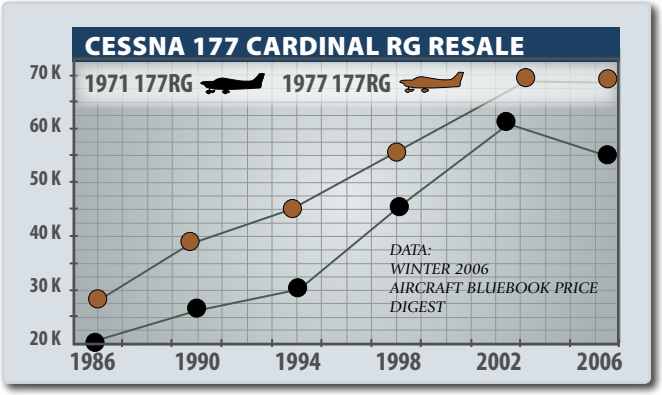
Photo: Mark Remaley




Drawings courtesy www.schemedesigners.com

## CESSNA 177 CARDINAL RG MODEL HISTORY

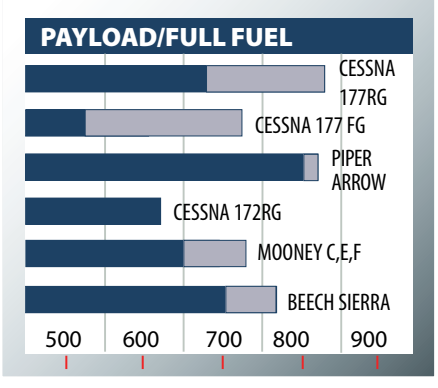
| MODEL YEAR | ENGINE | TBO | OVERHAUL | FUEL | USEFUL LOAD | CRUISE | TYPICAL RETAIL |
|---|---|---|---|---|---|---|---|
| 1971 177 CARDINAL RG | 200-HP LYC. IO-360-A1B6 | 2000 | $22,000 | 50 | 1170 | 135-140 KTS | $58,000 |
| 1972 177 CARDINAL RG | 200-HP LYC. IO-360-A1B6 | 2000 | $22,000 | 50 | 1155 | 135-140 KTS | $59,000 |
| 1973 177 CARDINAL RG | 200-HP LYC. IO-360-A1B6D | 2000 | $22,000 | 60 | 1140 | 135-140 KTS | $60,000 |
| 1974 177 CARDINAL RG | 200-HP LYC. IO-360-A1B6D | 2000 | $22,000 | 60 | 1140 | 135-140 KTS | $61,000 |
| 1975 177 CARDINAL RG | 200-HP LYC. IO-360-A1B6D | 2000 | $22,000 | 60 | 1120 | 135-140 KTS | $63,000 |
| 1976 177 CARDINAL RG | 200-HP LYC. IO-360-A1B6D | 2000 | $22,000 | 60 | 1093 | 135-140 KTS | $66,000 |
| 1977 177 CARDINAL RG | 200-HP LYC. IO-360-A1B6D | 2000 | $22,000 | 60 | 1093 | 135-140 KTS | $68,000 |
| 1978 177 CARDINAL RG | 200-HP LYC. IO-360-A1B6D | 2000 | $22,000 | 60 | 1093 | 135-140 KTS | $70 ,000 |

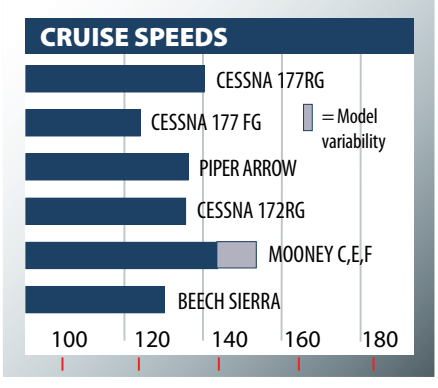


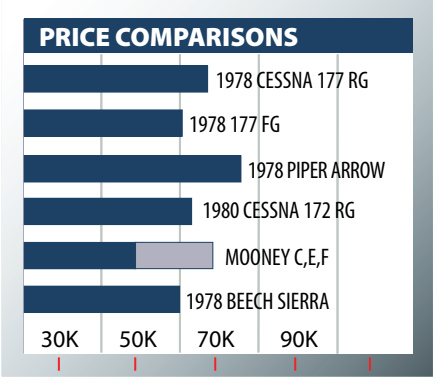

## SELECT RECENT ADs

| | |
|---|---|
| AD 00-06-01 | FUEL STRAINER REPLACEMENT |
| AD 97-01-13 | FUEL, OIL, HYDRAULIC HOSES |
| AD 88-12-12 | FUEL STRAINER QUICK DRAIN CONTROL |
| AD 87-20-03 | SEAT TRACKS (ALL CESSNAS) |
| AD-86-24-07 | ENGINE CONTROL MODIFICATION |

## SELECT LATE-MODEL COMPARISONS



*The Cardinal's IO-360 Lycoming is one of GA's more reliable engines. Other than cam problems, its only Achilles' heel is the Bendix dual mag.*

but without the means to afford a more powerful airplane like the Debonair. Cessna didn't help itself with a base price on the RG of $24,795—several thousand dollars more than the Mooneys of the time.

The original fuel system was an unusual (for Cessna) design that had only on and off settings. This occasionally caused problems, since it's possible for one tank to empty more quickly than the other. But ingenious Cardinal RG owners have found that this can be resolved in flight with a short but healthy sideslip. The tanks then feed equally for the remainder of the flight. The problem also occurs in later models with left-both-right-off fuel selectors, but here, the fix is simply to switch to the fuller tank for a few minutes.

There were several minor improvements to the Cardinal RG during its production run. The 1972 model gained a few knots in cruise and a slightly better climb rate thanks to a new prop. The gear system also gained some improvements, with mechanical switches moving to a more trouble-free magnetic setup. Both the hydraulic and electrical control systems changed, each step a small improvement. Also, the fixed cabin steps were dropped. They tended to expose the bottom of the fuselage to even more grief if the aircraft landed with the gear up. Instead, small foot pads were placed on the main gear struts. In addition, landing and taxi lights were moved from the wing to the nose, a feature that many feel wasn't an improvement because the higher vibration levels in the cowl shorten the life of cowl-mounted landing lights.

In 1973, the fuel capacity was raised from 50 gallons to 62 (60 gallons useful), improving the airplane's flexibility and usefulness for instrument flight. Along with the bigger tanks came a more conventional left-both-right-off fuel selector. The doors sprouted latch pins to help hold them closed in flight and the cowl was streamlined.

Prior to 1976, the instrument panel was higher in front of the pilot than the right-seat passenger. This was nice for the passenger but limited panel space for added avionics. In 1976, the instrument panel was redesigned and enlarged and a simplified landing gear hydraulic system was offered. This gear configuration was maintained through the end of production except for the powerpack change in 1978. For the 1977 model, the aircraft received a fuel selector that gave it commonality with other Cessna singles, had a more positive detent and was supposed to be more easily maintainable. And finally, in 1978, the aircraft got a 28-volt electrical system and an improved gear retraction power pack that cut retraction time in half, to six seconds.

Production of the Cardinal RG ended after the 1978 model year, with 1366 aircraft built. Unlike many designs, the 177RG didn't linger on with production trailing off to a trickle; about 100 airplanes were built that last year. However, in 1978, Cessna introduced the larger, more powerful Skylane RG and it's likely the manufacturer didn't want to wind up competing with itself. Interestingly, 177 Cardinals were built in France under contract and occasionally turn up in the U.S. These were internally corrosion proofed with zinc chromate.

## CABIN

Cessnas are big favorites with passengers, for several reasons. The cabins are generally quite roomy and the high wing makes for a cool, shady ride as well as a better view. The Cardinal adds to this with a wider cabin than the 172 or 182, low sill height and wide doors.

But those big doors—four feet wide—can be a problem on windy days. They're fairly light and can fly right out of your hand if they get caught by a gust, causing damage to the hinge or the skin ahead of the door, or both. The doors also have proven to be leak-prone. Some of the doors fit too tightly, others too loosely, due to either poor quality control in production, subsequent wind damage, or both.

Air leaks mean cold air and some Cardinal owners report that the back seat gets pretty chilly despite Cessna's attempts to warm things up with heater ducts. Careful sealing of potential air leaks in the cabin can bring some improvement, but a lap blanket for backseat passengers is useful when the ambient temperature falls below zero.

Many owners assume that if the door leaks air it also leaks water. The windshield has also been implicated in water leaks. But water leaks, for the most part, seem to come from the fairing joint at the wing root and owners and mechanics have come up with a fix for this leak that owners can do easily. Still, many owners find a hand towel is a useful checklist

item for IFR flight.

As noted earlier, visibility from the front seats is among the best in any Cessna. With the seats slid forward into flight position, the pilot sits about even with the wing's leading edge. This allows a view around the wing during maneuvering. The seats themselves could be ordered with vertical height adjusters—a boon to both short and tall pilots.

At the other end of the cabin, the baggage compartment is, to put it mildly, oddly shaped. Cessna had to put the wheels somewhere and they wound up in the baggage bay. The usual Cessna cavern has a big hump in the middle of it, right next to the baggage door. This sounds worse that it is in practice. The baggage compartment holds a huge volume and Cardinal RG owners use the hump as a divider. The baggage door is wide, but what won't fit through the baggage door will go in over the backseats.

One owner commented: "We had occasion to stuff the entire contents of a freshman girl's dorm room into the baggage compartment one time. Well OK, her trunk had to go into the backseat, but everything else went into the baggage compartment. Try that in your Mooney."

An interesting exercise is to try to load a Cardinal RG out of CG. It's tough to do. You are more likely to go out the front end of the envelope than the back, especially with a heavy pilot and instructor and no baggage. In the Cardinal RG, at least, the 25 to 50 pounds of undefined "stuff" most of us leave in the baggage compartment becomes useful to counteract forward-CG problems.

## PERFORMANCE

Pilots say that the Cardinal RG makes for a good, stable instrument platform, but it's still nimble. "Compared to a Skylane RG," said one, "it's like a sports car." As noted above, the speed is good in its class, although not up to that of the Mooney. Owners report cruise of about 140 to 145 knots at 11 to 12 GPH, or about 135 knots at 9 to 10 GPH. The RG doesn't get its speed from raw power, so proper rigging is important in obtaining book speeds.

Cessna's flaps are among the biggest in the business and the Cardinal RG uses them to get respectable short-field performance for a four-place retractable. Landing distance over a 50-foot obstacle is a claimed 1220 feet, shortest in its class.


Despite the higher horsepower, the Cardinal RG's takeoff performance (T/O Roll: 890 feet, T/O over an obstacle: 1585 feet) falls short of the later fixed-gear Cardinals (T/O Roll: 750 feet, over an obstacle 1400 feet). While some of this is due to the higher gross weight, another factor is the large nosegear door that sits immediately behind the propeller when the gear is down. Cardinal RG pilots say they can tell if the nosegear is down without looking at the gear lights simply by the vibration the gear door induces. This vibration also means that the nosegear door hinge is an item to watch for wear.

Because all three gear legs retract aft, there is a noticeable pitch-trim change during both extension and retraction. On takeoff, experienced owners take advantage of this by letting the aircraft accelerate to the target climb speed and then retracting the gear. The change in CG brings the aircraft into climb attitude with almost no input required from the pilot.

The pitch change during gear extension is easily canceled by lowering 10 degrees of flaps at the same time. In IMC, some pilots like to take advantage of the gear's drag and pitch change by lowering it right at the outer marker. If you set up your speed carefully in advance, you will find that only slight power adjustments are necessary to maintain a stabilized descent on a 3-degree glideslope. The stabilator in the Cardinal RG has been the subject of a lot of discussion. While it's less sensitive than some other stabilator-equipped aircraft, it's much more sensitive than the stabilizer/elevator combination that most Cessna pilots know and love. More than a few folks transitioning from the 172 or 182 to the Cardinal RG have embarrassed themselves by crow-hopping down the runway. A good checkout with careful attention to the special needs of the stabilator is a must, but once mastered it becomes a non-issue.

*The above should be a periodic experience for Cardinal owners. The gear system can be reliable, but only if it's treated to occasional preventive maintenance. (Photos courtesy Keith Peterson.)*

## THAT LANDING GEAR

Through the eight years of its production, the Cardinal had four different landing gear systems, as Cessna strived to correct all its quirks. Major

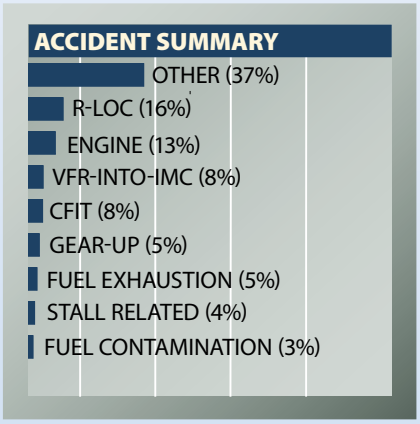
## ACCIDENT SCAN: ODDBALLS AND ENGINES

One challenge in reviewing the accident history of the Cessna 177RG is that there aren't that many of them so the number of accidents is relatively low. In the 12-year period between 1992 and 2004, we found only 76 RG mishaps, the results of which are summarized here. Twenty-one percent of these involved fatalities, a relatively low number compared to other airplanes in this class.

We found both good news and bad news in the accident history. First the good. Although it has quirky, maintenance-intensive landing gear, we found only two incidents in which landing gear failure or design weakness were cited as potential causes. This is a lower incidence than we've seen with other Cessna models and we think that indicates that owners are either keeping up the maintenance or the gear isn't as troublesome as we sometimes think. For example, we see many more reported gear problems in the Cessna 210.

The bad news is the Lycoming IO-360. In this sweep of accident records, we generously excluded maintenance-related engine stoppage reports from the engine-failure category. (We lumped those into the "other" category.) We found two reports of engine failures due to the governor gasket issue, for instance. We could blame those on the engine, but this time, we blamed the mechanic.

Nonetheless, as an accident cause, engine failure—sometimes unexplained—finished in third place, relatively unusual for singles. Had we lumped in the exclusions, it would have finished second. We have noticed the same pattern in the Mooney M20 and Piper Arrow series using the same engine. We don't have a ready explanation for this, but it's a noticeable and persistent pattern in the data. It may relate as much to pilot training, habits and predilections with regard to other accident causes as it does the engine itself. We simply don't have enough supporting data to pin this down with confidence.




components remained the same but plumbing and controls evolved. The first, most problem-plagued one on the 1971 and 1972 Cardinal RGs, was a Rube Goldberg combination of electrical and hydraulic components. Its weakest links were electrically actuated main gear downlocks and mechanical position switches.

The 1973 Cardinals got magnetic position sensing switches which held up better to the elements, hydraulic downlock actuators that improved reliability and direct control of the gear movement through a hydraulic valve rather than an electric switch. By 1974, the hydraulic system was almost completely in control of the gear, although a complex electrical control system remained. There are many stories told about Cardinal gear issues, most of them inaccurate, but perhaps more than any other Cessna, the early Cardinal gear systems benefit from a mechanic with prior Cardinal knowledge.

In 1976, Cessna finally got it right, removing all of the electrics from the gear system in favor of fully hydraulic gear using only two switches: a pressure switch to control the hydroelectric gear pump and a squat switch to keep the gear down while on the ground. While any of these gear systems are dependable if properly maintained, 1976 and later Cardinal owners are most likely to report a fully trouble-free ownership experience.

Finally, with the 1978 models, the 12-volt Prestolite hydraulic power packs were eliminated in favor of a 24-volt power pack of Cessna's design. This has proved to be the most satisfactory of all the gear systems and, of course, would be the one to choose if cost considerations and availability permit—only 100 RGs were built in 1978. There are other landing gear issues too, not related to the hydraulics. The most serious is the main gear actuating cylinder rod ends, which had a nasty habit of breaking off at inopportune moments, rendering the main gear inoperative. Actually, the main gear dropped to in-trail position and for a while, there was talk about carrying boathooks to reach down and pull it into the locks. But replacing the rod ends is a more permanent solution. Have your mechanic check for grease zerk fittings on the rod ends. If they are there, you have the old rod ends.

At any rate, buyers should check to see which, if any, of Cessna's recommended service instructions have been applied to the model being considered. There are at least eight of them, including numbers 71-41, 72-26, 73-28, 74-26, 75-25, 76-4, 76-7 and 77-20.

The landing gear raises the issue of proper maintenance. Experienced Cardinal RG owners will tell you that properly maintained, the landing gear is every bit as reliable as the gear on any other aircraft. The problem is finding a mechanic who really understands the landing gear, as well as the rest of the airplane. Proper rigging of the gear is set forth in great detail in the maintenance manual and careful adherence to these procedures usually results in a reliable landing gear system. This is where the owner organization proves its worth, with a lot of useful and detailed advice as well as referrals to knowledgeable Cardinal mechanics.

### OTHER MAINTENANCE ISSUES

The Lycoming IO-360-A1B6D engine in the 1973 to 1978 Cardinal RGs has a couple of notable idiosyncrasies. One is that it uses the infamous dual magneto that puts two magnetos on a single shaft, making the shaft a potential single-point failure item that can rob you of all engine power instantly if it fails.

The Cardinal RG is not the only aircraft using a dual-magneto engine — some Mooney models and Beech Duchess models do also. The 1971 Cardinal RG used the IO-360-A1B6 engine, with separate magnetos. This engine is approved for all Cardinal RGs, but getting an exchange

at overhaul time can be costly. The dual-magneto engines were recently a subject of Special Airworthiness Information Bulletin NE-06-08, which alerted owners and mechanics to a prop governor hazard that "could result in loss of engine oil leading to engine failure." Not only could it, it has. The oil loss results from omission of a plate between the prop governor drive pad and the prop governor itself. The plate is between two gaskets and is often thrown away with the gaskets when the old governor is removed. Unfortunately, the gasket without the plate often takes 15 minutes or so to fail, setting up the pilot for an off-airport landing.

## OWNER ORGANIZATIONS

One of the biggest selling points for all Cardinals is Cardinal Flyers Online (CFO). This model-specific organization with over 2000 members maintains a large and complete Website (www.cardinalflyers.com) that is a treasure trove of data and advice on Cardinals. Much has been contributed by members, but the operators of the site, Keith Peterson and Paul Millner, have become experts in every detail of Cardinals. CFO was the first organization to call attention to the prop governor plate problem and was instrumental in getting the recent SAIB published. Most of the fixes or techniques noted in this article have been documented on the CFO website.

In addition to the website, CFO sends out an almost daily email digest containing messages from members, replies from other members and comments from both Millner and Peterson. Past digests are maintained on the site, with a search facility that lets you search all the digests from the most recent (#2851 at this writing) to the earliest digest in March 1997. Membership in CFO is $34 a year. Many owners find that the Cessna Pilots Association (www.cessna.org) is also a good source of assistance.

## MODS

Because it attracts somewhat of a cult following, the Cardinal has also attracted quite a few modifications over the years, with some shops specializing in the type. You can turn the airplane into a fast flight level

*Cardinals are renowned for their barnlike cabin doors, as shown in Ken Towl's 1975 model, above. The baggage compartment is awkwardly bisected by a hump to contain the landing gear, right. Early Cardinals have a unique dip-down glareshield, as shown in the 1972 RG owned by Ross Youngblood, right.*

flyer with a turbonormalizing system from Tornado Alley Turbo at www.taturbo.com or 888-359-4264. Another engine mod is available from Firewall Forward (www.firewallforward.com or 800-444-0556) to install high compression pistons in the stock IO-360. Speed modifications of various kinds are available from several sources, including wing tip mods and fairings for the exhaust pipe. Contact www.aircraftspeedmods.ca or 204-728-7618 for more information.

As mentioned on page 4 of this issue, vortex generators are available for the Cardinal from Micro Aerodynamics at www.microaero.com or 800-677-2370. Owners report good results with these mods. Along the same lines, Horton makes a STOL kit. Contact Horton at www.airsport.com.

Hartzell and McCauley continue to offer good deals on three-blade prop conversions. Contact www.hartztellprop.com or 937-778-4376. Find McCauley at www.mccauley.textron.com or or 800-621-7767.

## OWNER'S COMMENTS

This Cardinal RG is my third aircraft (following a 1979 Warrior II and 1977 Arrow III, both purchased almost new). I use N1587H for carrying machinery throughout the eastern U.S., as well as for holiday trips. My enthusiasm for the 177RG is tempered only by what it has cost me to bring a 30-year-old, neglected bird into acceptable condition. I wouldn't have attempted the task without the


*Mark Remaley has used Cardinals in his aerial photography business for years and sent this photo of a Michigan-based 1977 model.*

detailed technical information and support available through Cardinal Flyers Online. If you want to tell people anything about Cardinals, get them to the CFO website.

The 177 cabin is very spacious for its class and its great visibility and legroom make it very popular with backseat passengers. The strutless design, with low sills and wide-opening doors, make passenger and machine loading a breeze.

The baggage compartment is divided by the landing gear, but it carries a remarkable volume and the rear seat can easily be removed for more space as required. For example, two beach chairs, three large suitcases, groceries and linens for a week, normal tools, oil, chocks and covers. And did I mention the two full-size bicycles?

As far as operating costs, I've averaged about $25/hour on fuel and oil. Insurance now costs me just over $1400 per year for $80,000 hull and $1 million smooth, a few hundred less than when I had no time in type. (I have something over 1000 hours, instrument rating, annual recurrent training and an outside tiedown.)

There are two tasks that can trip up new Cardinal pilots: planning descents and flaring for landing. Newbies need only refer to the CFO site for thorough discussions and suggestions. Other than that, flying the RG is simply delightful, but not delightfully simple. It calls for well-developed and practiced operating procedures, but it repays the competent pilot with great traveling performance, especially after the first hour of fuel is burned off.

My carefully rigged RG trues around 160 to 162 MPH rich of peak (10+ GPH) around 155 MPH lean of peak on about 8 GPH. Most of my trips are solo with 300 to 400 pounds of payload, plus charts, tools, baggage and full fuel, using most of the 1037 pound useful load. Cruising lean of peak, the 60 gallons available provide far more endurance than I want to use.

Ken Towl
Via e-mail

This was my first injected engine and I always hated the hot start. The problem was cured with a LASAR Ignition System. My mechanic put her up on jacks for a gear swing during the first annual. We found that the nosegear door did not close properly and that an item called a "snubber" was missing from the lower cowling. We replaced all the hydraulic hoses, cowl flap hinges, the gear door with hinges and added the snubber back. I was surprised that these changes resulted in about a 4-knot speed increase.

I generally burn 9 to 10.2 gallons per hour, depending upon power setting. At 25 inches squared, I cruise in the 155 to 160 MPH range. I flight plan for 132 knots. I try to limit each leg to approximately 3 to 3.5 hours, but that has more to do with the size of my bladder than fuel burn.

As with any airplane, there are some downsides to the Cardinal RG:

1. The rear seat is cold in the winter months. This is due to the combination of the big doors that don't seal very well and a poor heating system design.

2. Hot weather (80-degrees plus) tends to kill rate of climb to a boring 200 FPM with full fuel and three on board. Put the temperature in the 70-degree range and she'll climb at about 500 FPM. Temperature in the 60s and below will provide a wonderful 1000 FPM rate.

3. One of the very common problems is an uneven fuel burn. Early models like mine have a fuel selector that is "on-off-both." I have learned to overcome the problem during the preflight. I remove the fuel caps from both tanks.

I then find the weep hole about four inches in from the vent opening and block it with one finger while blowing into the vent as though I were playing a wind instrument. I stop the process when I can hear the fuel gurgling in the opposite tank. I repeat the process on the other side, replace the caps and go. This usually works very well with the resultant even fuel burn.

4. The big doors can be difficult on windy days. I generally make the right seaters wait for me to exit and walk around the airplane to open and hold the door. Because of the sleek, strutless design coupled with the big doors, it doesn't take much wind to rip the door out of your hand. If the wind is strong enough, it can fold the door back against the forward fuselage, which is a costly repair.

Fred Coste
Via e-mail

We have owned N177BS for 10 years. We bought it as a salvage airplane and it has become a labor of love. The restoration has gone well and we have won several awards at Cardinal fly-ins around the country.

We are active members of Cardinal Flyers Online. Their Website is a goldmine of knowledge and is a must for a Cardinal owner. Not

only are there people that write in with tips on care and maintenance, but also resources for complete care of the Cardinal. We couldn't do without it!

The retractable Cardinal is a beautiful airplane in flight and looks fast just sitting on the ramp. Our fuel burn is less than 10 GPH on a cross-country. Very economical to maintain. There's one thing that we recommend: Be proactive in the maintenance. If the owner does his job and follows up on the checks and changes the hydraulic hoses every five years or so, there will be no problems. As far as we know, there have been no ADs on the landing gear. In fact, there are very few problems with the airplane. It is a joy to maintain and fly. The RG is definitely a cross-country airplane. It was built to go. If you want to stay in the pattern, get something else. This airplane almost demands to be flown places. We have the long range, 62-gallon tanks. Often we fly four hours and could fly longer except for physiological factors.

During my time, I have owned 13 planes. My last was a Turbo 210. For us, the Cardinal RG is a perfect balance between economics, comfort and speed. We cruise at 135 to 145 knots and travel from Florida, the Bahamas, Texas and all over the East Coast.

Jimmy and Sandy Honeycutt
Via e-mail

## SOFT HANGARS

*(continued from page 22)*

hangar such as the Big Top model pictured on page 20 can be erected for about $10,000. Unlike a T-hangar, it can be built as a free-standing structure, if the airport will allow it. For those airports that will, a free-standing hangar may be the only short-term solution.

In 15 years time, a fabric hangar may need replacement fabric, costing about a quarter to half of the original cost. (If you don't plan to keep it that long, this may not be a consideration.) Resale potential of soft hangars is an unknown but metal hangars at airports with long waiting lists are quickly snapped up when put on the market and most at least hold their purchase value, if not a higher resale value.

Bottom line: If you want a fully enclosed hangar, we think conventional metal construction is the better way to go, if you can make it work. It's competitive in cost and if built to the latest hurricane codes, more durable. Depending on local codes, fully enclosed fabric structures may require just as much site work—concrete footers and floors—as a metal hangar so savings for the equivalent protection are elusive. Metal hangars also have moisture issues, but far less so then enclosed fabric structures.

An open-ended fabric sunshade is appealing, in our view. It can be built for about a third less than a typical $15,000 metal hangar, requires minimal site work and you can save money by erecting it yourself. If it's anchored, you'll need permitting, but whether anchored or not, you can take it with you if you leave.

Further, at some airports, individual owners may be able to erect free-standing fabric sunshades on their own, where an individual metal hangar or a block of hangars wouldn't be an option. In our view, that's better than letting the airplane bake in the sun, hammered by rain and hail or buried in snow. And therein lies the allure of soft hangars.

*Ben Barnard is* Aviation Consumer's *assistant editor.*

### CONTACTS...

Big Top Manufacturing
800-277-8677
www.bigtopshelters.com

Shelter Structures
www.weatherblockshelters.com
800-330-9294

Fabric Structures-USA
www.fabricstructures-usa.com
800-424-5609

## VGs

*(continued from page 8)*

an uncoordinated stall leads to a rapid yaw, roll and pitch down, often resulting in ground impact at low altitude. This phenomenon has come to be known as a "moose stall" in Alaska, a unique mishap that plagues pilots doing game spotting at low altitude. Owners tell us VGs change this behavior from a sharp break to a more gentle bobbing, giving the pilot time to recover before impact.

### CONCLUSION

While it may be true that VGs are engineering crutches that correct compromised wing design, after flying VG-equipped airplanes and interviewing owners, we believe they work as claimed. We found no evidence that the manufacturers are exaggerating performance claims, although performance is likely to vary case by case.

For twins, VGs are an inexpensive way to improve low-speed handling, control and to reduce Vmc, thus increasing the level of safety. Period. We think they're among the top safety items any twin owner should have. For singles, VGs seem to give most of the benefits of a STOL kit, without the added weight, with improved low-speed handling, more docile stalls and increased control effectiveness that pays off in crosswinds. Maybe you need those benefits, maybe you don't.

But maneuvering and landing accidents account for the largest proportion of general aviation accidents and any modification that lowers stall speed and improves low-speed handling is an unqualified safety enhancer, in our estimation. For that reason, as a safety mod, we would put VGs right up there with shoulder harnesses for all of the seats.

*Rick Durden is an Aviation Consumer contributing editor.*

## LETTERS

*(continued from page 3)*

*ated signals that a receiver reads and pauses, usually during a scanning process. Most receivers have at least a few of these.*

*Cross modulation is a form of interference caused when one modulated signal impinges on another. It can cause distortion or poor audio or transmission quality. How well it's controlled is often a function of circuit design.*

### Bike Friday

Your article on folding bicycles left off one of the best companies in the field—Bike Friday (www.bikefriday.com). They have over 40 models of folding bikes ranging from $695 to over $5000. Their selection includes touring, road, mountain and recumbent folders. You can get various sizes to ensure a comfortable fit. They even have tandem folding bikes.

After trying several models of folding bicycles, my wife purchased two Bike Fridays for our Cessna 182. I can fit both of them into the baggage compartment and still have room for a couple of bike bags, support gear and the helmets. It takes about five minutes to set them up or fold them and I can get them through the airplane's baggage door. The folding pedals, while a little detail, really help with the fit.

My wife and I ride them all day long. They're even more comfortable than my regular, full-size bike. Most weekends during the summer and fall we load the bikes and take off for a fly/ride day trip. The bikes are a pleasure to ride. We are not into distance or speed, just an enjoyable ride with nice scenery and/or interesting towns. And the best part is that we get to spend time doing two things we enjoy—flying and biking.

David Fisher
Brookline, Massachusetts

*Actually, we contacted Bike Friday during our research and the company told us it didn't have a suitable product in our stated price range. They've since changed their mind and are sending a bike for a follow-up review.*

**FEEDBACK WANTED**

## PIPER SUPER CUB

**For the April 2006 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Piper Super Cub. We want to know what it's like to own these hardworking taildraggers, how much they cost to operate, maintain and insure and what they're like to fly.**

**If you'd like your airplane to appear in the magazine, send us any photographs you'd care to share. We accept digital photos in the tif or jpg format, e-mailed to the address below. We welcome information on mods, support organizations or any other pertinent comments. Please send correspondence on the Super Cub by February 15, 2006 to:**

**Aviation Consumer**
**P.O. Box 575**
**Laurel, FL 34272**
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**avconsumer@comcast.net**