Are you WAsting AvgAs?

By Aviation Consumer Staff

*This article originally appeared in **Aviation Consumer** magazine, Nov. 2005.*

Airmanship

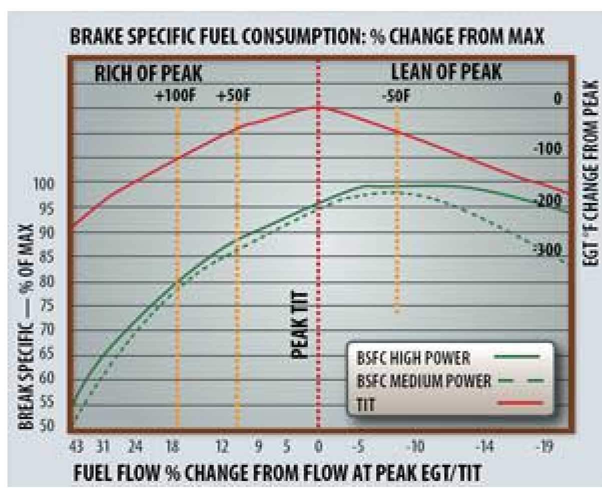
However unpleasant the specter of $4 avgas may be, it has become a harsh reality. The $5 barrier fell in early 2005, and as we go to press, Signature at Teterboro, N.J., can claim the highest avgas price in the country: $6.10. [Editor's Note: At the end of 2007, it was up to $8.05.] In the U.S., fuel has never been the most expensive component of flying cost, but it could soon get that way. And even if it doesn't, no other factor more threatens GA growth and usefulness than the rising cost of gas.

Although aircraft owners can't do much about the global price of crude oil, we can certainly do more to make our airplanes use less of it. Some of these measures require minor or major investments in the airframe, but the largest gains are to be had simply by flying the airplane more efficiently and learning to lean effectively. We're loathe to say it, but owners of some twins are coming to the unwelcome realization that a handful of modern, single-engine airplanes are not only faster but cost less than half as much to operate as even a modest twin. The comfort of having a second engine is likely to grow increasingly expensive, so certain aspects of the used single-engine market may soon heat up.

Herewith, presented in order of cost effectiveness, are an even dozen ideas on how to either save gas directly or reduce fuel-related operating costs. Some require minor habit changes; others require modifications or upgrades to the aircraft.

Idea 1: Lean-of-Peak

This topic has been addressed ad nauseam during the past five years, including by us. We long ago grew weary of ill-founded arguments from mechanics and engine shops that lean-of-peak operation somehow causes burned valves or reduces engine life. We reject these claims and so should you.



Brake Specific Fuel Consumption Graph (click here for larger version -- 124 KB)

As far as we're concerned, the data that indicates that correctly executed lean-of-peak operation both saves fuel and lowers EGTs and CHTs is inarguable and people who claim otherwise don't know what they're talking about. We can't make it any plainer than this.

But there's always a catch. Lean-of-peak operation isn't a panacea. It doesn't work well in all engines, it requires reduced cruising speed and you need good instrumentation and some basic knowledge to use it to best advantage. And sometimes, it doesn't make sense from an operational point of view. Lean-of-peak operation isn't something for nothing; you'll have to fly slower to realize efficiency but the gains are usually worth it.

Here are some numbers. Our turbocharged Mooney 231 burns about 13.5 GPH in the mid-teens to fly at a true airspeed of about 165 knots, leaned rich-of-peak. Operated lean-of-peak TIT, the airspeed drops 10 knots to about 155 knots or a little less, on a fuel flow of 9 GPH. The rich setting delivers about 12 NMPG, the lean setting about 17 NMPG, a 42-percent improvement in economy. Looked at another way, flying lean-of-peak EGTs/TITs is like having not quite half again as much fuel capacity without paying for it.

And fuel capacity -- endurance, really -- is of itself an economy enhancer. Here's why: Having additional endurance makes it more likely that you can complete a trip without a fuel stop. For turbocharged airplanes, fuel stops are efficiency killers because the long climb (back to altitudes where the turbo's speed is a plus) requires time and fuel. Even in a non-turbocharged airplane, fuel stops cost time and fuel; they never improve efficiency. Increased endurance through lean-of-peak operation translates to more loading and weather options, too. If you have more endurance, you can reach a wider range of alternates if the weather tanks or you can shortload fuel in favor or more cabin payload.

Lean-of-peak operation works well in most Continental fuel-injected engines and somewhat less well in Lycoming fuel-injected engines, but is still worth considering as an endurance extender.

We're told by George Braly of General Aviation Modifications (GAMI), whose research has recently illuminated an understanding of lean-of-peak operation, that carbureted engines can also be operated lean of peak if partial carb heat is used to increase the induction temperature. This improves fuel atomization and distribution and reduces so-called dropouts, when fuel vapor condenses in the induction system's twists and turns. Although we've flown Continental and Lycoming injected engines lean-of-peak, we haven't tried this method in a carbureted engine. Although we're skeptical of its practicality, we think it's worth experimenting with.

Whether injected or carbureted, an engine should have a digital multi-probe engine monitor with both EGT and CHT before lean-of-peak is attempted. At high power settings, it's possible to damage valves and cylinders by hamfisting the mixture control. (This is why some engine shops think LOP damages engines and, done incorrectly, it certainly has that potential.)

And there are circumstances where lean-of-peak operation makes little sense, usually when flying into a stiff headwind when the fuel economy tradeoff just isn't worth the slow groundspeed. In this case, go rich of peak and pay for the gas. For more technical detail on lean-of-peak operation, visit **GAMI** or read other lean-of-peak articles **here on AVweb**.

Idea 2: GAMIjectors

Beginning in 1996, GAMI reinvigorated research into aircraft engine technology and among other ideas -- including a focus on lean-of-peak operation -- this yielded GAMIjectors. These are custom fuel-injector nozzles that precisely match the fuel going into the cylinder to the air available through the induction system.

GAMIjectors from General Aviation Modifications (GAMI)

GAMIjectors yield generally smoother operation and definitely more-even leaning, making it possible to operate lean-of-peak without undue roughness. Not all fuel-injected engines need or will necessarily benefit from GAMIjectors, but our surveys reveal that most have. GAMIjectors range in price from $699 to $999, depending on engine model. (Visit GAMI's **Web site** for more.) If GAMIjectors are required for lean-of-peak flight, at current gas prices, the payback may be in as little as 150 hours.

Idea 3: AirNav

In our view, this is one of the most underutilized services in general aviation. For several years, **AirNav** has been tracking avgas prices based on voluntarily submitted reports from the field. This service is well executed and available for free to anyone.. Although using it won't save gas, it will certainly save money on buying gas -- a lot of money.

For example, if you were flying along the eastern seaboard [in late 2005] and needed a fuel stop in South Carolina, you could pay Signature $4.35 a gallon in Savannah, Ga., taxi down to the self-serve pumps and pay $3.79 a gallon or route through Darlington and pay $3.05. On a fill-up of a modest single, the most/least difference is more than 40 percent and well worth considering re-routing, in our view. Further, we think FBOs who are efficient and willing to accept lower margins deserve support. This also pressures higher-priced players to offer more competitive prices. AirNav has basic utilities that allow you to plan routing based on the lowest fuel prices.

Idea 4: Bigger Tanks

Tip Tanks

The hackneyed adage about never having too much fuel unless you're on fire definitely applies to economy considerations. One reason is the aforementioned extended endurance, which allows skipping a fuel stop. The second is buying cheaper fuel where you find it -- or where **AirNav** finds it for you -- and carrying it around with you.

While the airlines have learned that tankering fuel is an economy no-no, that proviso doesn't apply to small, piston aircraft. Yes, you burn a little more gas to haul your stash of fuel, but not enough to offset even a 25-cent-per-gallon price delta, and we've seen price breaks between the highest and lowest of over $2. Extended capacity tanks are available for a range of models, mostly mid- to high-performance singles. Adding even 15 gallons can make a difference if you fly trips to near the limits of the airplane's fuel endurance.

Prices on these systems vary between $4000 and $8000 and some include STCs for gross-weight increases. See **Aviation Consumer** March 2004 for a complete analysis. Extended-range tanks are a moderately expensive upgrade but can pay big dividends.

Idea 5: Check the Rigging

It's not unusual to see cruise-speed differences between two airplanes of the identical type and model year. Tracking down the reason for cruise shortfalls is black art but rigging is often implicated; ailerons are out of trim, the rudder doesn't center-up, flaps aren't completely retracting; gear doors don't close.

Rigging Ailerons

Recovering five knots through rigging tune-up is hardly unusual and, although the fuel-efficiency gain is a small one, it's nonetheless measurable and not expensive. Some caution is advised, however. If a shop isn't thoroughly familiar with your airplane or otherwise a whiz at rigging, you might make things worse. Rigging checks aren't expensive.

Idea 6: General Maintenance

The big items here are spark plugs, harnesses and magnetos and induction leaks, probably in that order. The onset of roughness during leaning is often caused by a fouled or defective plug, old harnesses or a magneto past its prime. If you can't lean effectively -- you'll probably be unable to run lean of peak -- you're wasting gas. Another trouble-causer is leaking induction pipes; these too will cause roughness and an inability to run lean of peak, not to mention EGT and CHT spikes above normal. Last, check air and fuel filters. These are normally tended to at annual but may have been missed last time around. This is routine, inexpensive maintenance.

Idea 7: Optimize Altitude

This is a cheap fix if ever there was one. When you last looked at a winds-aloft forecast, did you really look? If you didn't, you may have given up speed into a headwind or failed to take advantage of a blistering tailwind because you weren't willing to climb a couple of thousand feet higher. That's the same as wasting gas.

As a survival skill, some airlines are masters at altitude optimization and most flight planning programs will crunch "what-if" numbers to find the most favorable winds based on the airplane's typical flight profile.

Again, airplanes with the most altitude capability -- read that as turbocharged -- will benefit the most from altitude optimization. GPS, airdata and real-time winds aloft help with optimization, as we discovered in reviewing the EFB software from TrueFlight. This program works in real time to optimize altitude choices.

Idea 8: Dump the Guzzler

If you can afford a twin with a pair of large-displacement, six-cylinder engines, you may not care about fuel economy. Then again, maybe you do, to the extent that you don't fly as much because filling it up costs nearly a grand. Timing the market to buy or sell right is fraught with peril but, in our estimation, prices on twins are likely to remain soft. It's difficult to foresee market forces that will reverse this trend.

How much does it cost to fill up *your* tank?

On the other hand, if you're thinking about a more fuel-efficient airplane -- any of the Mooney models, Diamond's DA-40 or even a used Cirrus SR-20 -- it might be better, so shop sooner rather than later.

Idea 9; Turbocharging

Turbocharging or turbonormalizing isn't normally thought of as an economy measure but it can be, provided that the airplane is flown high enough to take advantage of the turbo's altitude capabilities, the pilot is reasonably canny about altitude optimization and lean-of-peak operation is considered.

A gas-swilling turbocharged twin will never be an economy leader no matter how it's flown. But a turbocharged Bonanza, Mooney or Cessna 210 can be. Switching from a normally aspirated airplane to a turbocharged airplane as an economy measure only makes sense if the owner flies long trips frequently and is otherwise thinking about an upgrade. Otherwise, turbocharging's higher maintenance costs will more than offset any dollars in fuel savings. Still, if you lean correctly, you'll use marginally less fuel on those trips where climbing ramps up the speed, especially in tailwinds. Buying a turbocharged airplane or adding it to one you already own is a dubious return on investment if you fly under 100 hours a year.

Idea 10: Buy a Diesel

The diesels are coming, alright. Although the numbers aren't right yet, they soon will be. It makes no sense to sell your $150,000 gasoline-powered twin and buy a $450,000 Diamond TwinStar just to save gas. On the other hand, if you're shopping for a new airplane, it makes just as little sense not to at least look closely at the DA42 TwinStar.

Idea 11: FADEC

FADEC System

Full authority digital engine controls (FADEC) have gotten a lot of press but sales haven't followed. We think the reason for this is that the only flying system -- Continental's Aerosance-developed PowerLink -- is complex and expensive and its benefits are currently elusive. Fuel savings of 10 percent are reported by owners, but currently, you can do better by leaning aggressively. FADEC's benefit will arrive when 100LL avgas disappears. That hasn't happened, so FADEC goes near the bottom for cost effectiveness.

Idea 12: Speed Mods

Pulling up the rear in cost effectiveness are speed mods. Speed mods -- at least those that deliver on their claims -- increase speed by reducing drag or, looked at another way, they allow the same speed on less fuel. The usual rule of thumb is that it costs $1000 per knot of increased airspeed, which might translate to a tenth of a gallon or two of fuel savings.

In reality, speed gains from mods are sometimes elusive and that's also true of fuel economy based on drag reduction. That's why we put speed mods at the end of the list. The return on investment may or may not be worth it, either in speed or economy. Don't expect miracles, although some airframes will benefit enough to make the investment worthwhile.