



## **SAFETYGRAM**

February 06

Leaning... There is a large amount of information out there about leaning. When I learned to fly many years ago, there was not a lot of emphasis on leaning where I learned to fly. "We aren't flying high, leaning doesn't apply at these altitudes" was the mantra of the day. I flew general aviation airplanes regularly while in college and thought the only use of the mixture control was to turn on the fuel before engine start, and then to turn it off at the end of the flight. I had a silly fear that if I messed with that knob; I might end up with a very quiet engine because I did not know how to use the mixture control properly. Looking back, I know I never got the fuel economy listed in the POH. It is a good thing I never tried to go very far from home or I could easily have been out of fuel and ideas at the same time. Folks may think that is a pessimistic view but is it really? How much extra fuel gets burned when we don't lean properly. Most POHs tell us that the performance numbers are predicated on a properly leaned engine. We have checklist steps that remind us to adjust the mixture in various stages of flight. We even have a warning in the checklist that states, "Improper leaning procedures will greatly reduce endurance." All of these things are great if the pilot follows the guidance. Pilots must understand the reasons for leaning and also be taught how to lean throughout their training. It was a lot harder for me to start leaning after a break from GA flying than it would have been to learn it from the start.

First, why lean? The main reason comes right out of the POH. The performance, range, and endurance figures for your airplane, listed in the *Pilot's Operating Handbook* (POH), are based on a *properly leaned* engine flying in optimum conditions. That is all 'high altitude' stuff. We don't need to pay attention to that unless we are going somewhere, right? Let's think about this a moment. If we don't train to lean every time, what will remind us to do it later? I submit to you, the average pilot will not lean even on a cross-country unless he has been taught that leaning is part of every flight from the beginning of his training. Every month the NTSB website ([www.ntsb.gov](http://www.ntsb.gov)) is littered with accidents caused by fuel exhaustion. Referencing one I am familiar with, a non-aero club accident; the total flight time was less than the endurance figures from the POH. The pilot planned the flight using the POH and even thought he had reserve fuel. On paper it looked good! Why did he run out of gas? There are several reasons attributed to the accident, but one stands out. The pilot did not lean properly and his fuel burn was nearly twice as high as the POH chart indicated. Given that information, he flew about as long as the available fuel would allow and paid for the mistake with a broken airplane, and worse, injuries to his passengers. Learn all you can about leaning. Use the information while you fly—**every time**. Make proper leaning a habit and you will save fuel, prevent injury, and avoid embarrassment.

Next, How should I lean? There are several ways to lean. Most POHs will have a recommended leaning procedure listed in the checklist section or the performance section and there are generic techniques for those that don't. I have listed below several options taken from an article in *Light Plane Maintenance, May 2004*. The article gives ideas for many types of fuel delivery systems and there are subtle differences in each. Generally, they discuss options with EGT gauges and also without. If you don't have an EGT gauge, set cruise power and lean until the engine begins to run rough, then enrich the mixture until the engine smoothes out and enrich it a little bit more. This will put you a bit rich of peak EGT if it were installed and will come very close to most POH recommended leaning levels. If there is an EGT gauge, set cruise power and lean the mixture to peak EGT then enrich it by 50-100°. While best economy occurs at peak EGT, it is usually not recommended because it can cause detonation at higher power settings. The article goes on to give more specific techniques for different fuel injection systems and turbo/supercharged engines. Generally, the higher the power output capability, the more rich the mixture should be run to help keep these engines cooler, with some recommended at as much as 200° rich of peak EGT. As always, follow guidance in the aircraft's POH and you will not go wrong.

Finally, track the actual fuel burn on the aircraft you fly over time. How many gallons per hour are you averaging on most of your flights? Compare this information to that listed in the POH. Are you able to average the fuel burn numbers in the POH for your aircraft? If you fly at comparable altitudes and over time your aircraft burns one or two gallons per hour more than the POH chart lists, you probably should not plan a cross-country flight to the maximum range listed in the POH. Remember, the numbers in the POH are flown on a standard day with a brand new airplane, and you may not be able to get those numbers on the actual day you fly with the actual plane you fly. One final note, leaning is usually recommended at Density Altitudes above 3000'. Some of our locations are above that year round and others are on hot days so realize leaning may even be necessary on takeoff (and taxi) depending on your location. Again, use POH procedures and local procedures to ensure proper leaning in all phases of flight. Proper leaning will give you much better fuel economy than running full rich, and with proper planning will keep you from being surprised by an unexpected quiet from the front end of the airplane.

**FLY SAFE!**



**Lt Col Tom Padgett, Director of Ops & Safety, USAF Aero Clubs**  
**thomas.padgett@randolph.af.mil; DSN 487-4979, (210) 652-4979**