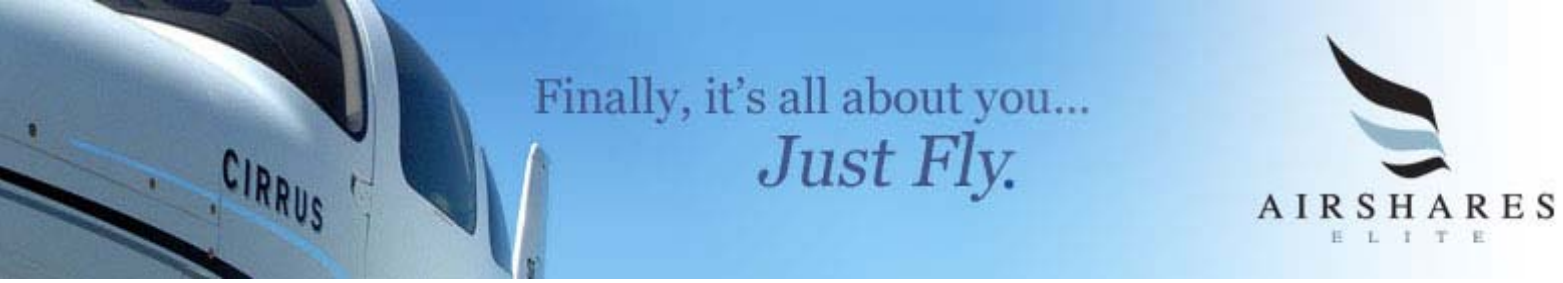
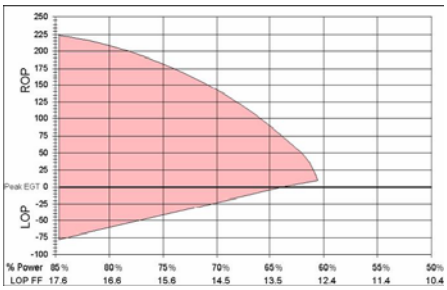


The Dirty Dozen: Top 12 Engine Management Errors

By Richard Bertoli, CFI

With the evolution of cockpit technology, specifically engine monitoring instruments such as the Avidyne EMax™ system found in our Cirrus, the light aircraft pilot has access to far more information than that single EGT gauge found on the vintage aircraft many of us learned to fly on. In step, the operation of the aircraft power plant has also evolved well beyond what many of us learned during primary training; "Pull the mixture back until it runs rough and then give it two twists forward."

The practice of "lean of peak" operations, a commonly debated topic on the internet forums, has become a widely accepted method for operating high performance engines equipped with this technology. With the help of groups such as Advanced Pilot Seminars, Tornado Alley Turbo, and even Cirrus Aircraft, lean of peak operation has never been easier, provided that the pilot truly understands the concept and has been properly trained in the technique for every phase of flight.



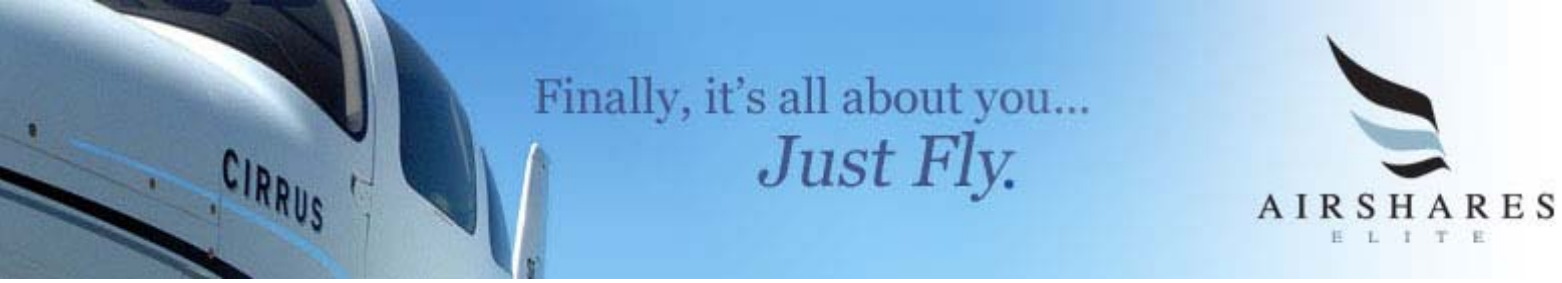
Herein lies the problem; many pilots simply get it wrong and it's not their fault. Engine management should not be introduced during transition training shortly after take-off on the student's 2nd flight in the airplane! The CFI would be lucky if even 10% of the information presented is absorbed. The cockpit is a terrible place to learn new concepts, especially one as foreign to most pilots as advanced engine management techniques.

The scope of this article is not necessarily a "How-To" on engine management, but rather an exposition of the errors I have seen in my experience as a Cirrus instructor and aircraft maintenance manager. The "how-to" part is best learned one-on-one with a competent instructor, and preferably after exploring the resources available on the AirShares Safety Site.

The following list is presented in sequential order of a typical flight, from pre-flight to shutdown, and applies primarily to the normally-aspirated engine in the Avidyne-equipped airplane, but turbo pilots should also learn something here.

1. Adding too much or too little oil to the engine during pre-flight.

Six quarts of oil in the sump should be considered both a minimum and a maximum level, give or take a ½ quart. Anything much more than six tends to be blown out the breather tube under the cowling, coating the belly of the aircraft with oil. Reading the dipstick on a warm engine



will invariably indicate a lower level than what is actually there because as much as a quart can be distributed throughout the engine innards before it eventually drains into the sump.

When departing on a long trip and the pre-flight dipstick reads 5½, go ahead and add a full quart. Please don't open a bottle and add only a partial quart. Pour in the entire contents of the bottle and dispose of the empty container accordingly. Once opened, these bottles leak and a partial quart stowed in the baggage compartment makes a real mess over time.

2. Not using a scientific approach to engine starting.

In extreme environmental conditions, hot or cold, the SR22 engine can be difficult to start. However, AirShares and others have published techniques that can help. All methods are most effective when used by pilots who approach the starting problem scientifically. Understanding that ignition requires fuel, air, and a spark in a particular combination, these pilots will make an adjustment to one or more of these ingredients to change the status quo. Repeatedly cranking the starter without making any other adjustments might have worked on your father's Oldsmobile, but this is not a scientific approach to starting an aircraft engine.

3. Excessive RPM setting immediately after start up.

This is one sure-fire way to reduce the life expectancy of an engine. After starting, and especially when it's cold, the engine RPMs should never be allowed to exceed 1000 RPM. It takes time for sluggish oil to warm up and coat the metal-to-metal contact points, providing the protection and lubrication it was designed for. The majority of the wear and tear on any engine occurs during those first few critical moments after start-up. Wait until the oil has reached a temperature of 75° before taxiing and 100° before run-up.

4. Arbitrary leaning for taxi and then forgetting mixture forward on take-off.

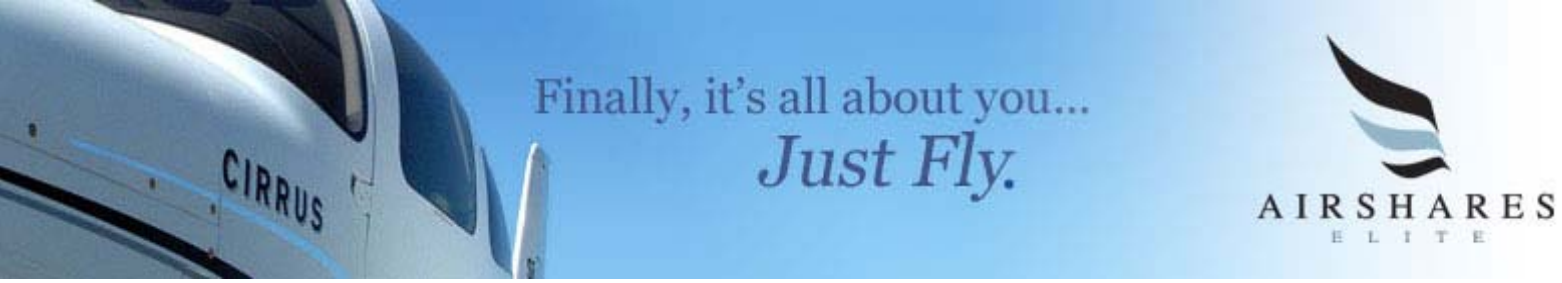
After the engine has started, the pilot should lean the mixture "brutally;" such that if take-off is attempted without the mixture full rich, the pilot will get a firm reminder from a stumbling engine. While this step is not included in the official Cirrus checklist, it is mentioned in the Cirrus Flight Operations Manual as a recommended practice to avoid spark plug fouling.

5. Over-leaning mixture in climb.

This is a very common mistake and I'm not sure why. During a full-power climb in the normally aspirated engine, the fuel flow setting should never be leaned further than what is approximated in the "Maximum Power Fuel Flow" placard, located on the upper right area of the instrument panel on all Avidyne-equipped aircraft. Some pilots practice the "Normalize" technique, zeroing out the EGTs very shortly after take-off and then maintaining those temperatures throughout the climb. This works best if the "Normalize" button is pressed

ALTITUDE	GPH
16000	17
12000	18
8000	21
4000	24
SL	27

MAX POWER FUEL FLOWS



as close to sea-level as possible, otherwise I find following the placard a far simpler and less workload-intensive method to achieve virtually the same result.

6. Not monitoring temperatures during the climb.

Cylinder head temperatures (CHT) should never exceed 400°, yet I have pages of engine data-plots from flights where unwitting pilots have allowed this to happen, especially in the turbo normalized airplanes. When CHTs approach 380°, the pilot must take action. Only if the pilot is monitoring engine parameter trends during the climb can excessive temperatures be avoided, especially under hot ambient conditions.

7. Reduced power setting during climb and top of climb.

With the exception of departures over extremely noise-sensitive areas, the power should remain at maximum throughout the climb and also through the acceleration phase until the airspeed stabilizes when leveling off at the final cruising altitude. This simply provides better performance and efficiently accelerates the aircraft to cruise speed.

8. Cruise power set too high for altitude flown.

Again, pilots get bits and pieces of information from many different sources, but sometimes fail to get the whole story. Some may have heard on the internet or from their instructor that the power lever can be set full forward and then the mixture leaned for Best Economy. This is sometimes true, but does not apply to all altitudes. At lower altitudes, the initial power setting should be reduced for the most safe and efficient lean of peak operation. Use the table on the right as a guideline, or simply set the power to 75% *before* leaning.

Altitude (MSL)	**Initial Cruise Power Setting**
2000 ft.	2500 RPM
4000 ft.	2600 RPM
6000 ft. and above	2700 RPM

9. High cruise power fuel flow not lean enough

Blindly following the Avidyne "Lean Assist" feature and settling on the fuel flow as soon as the screen reads "Best Economy" can result in a fuel flow that isn't lean enough, especially at the higher power settings. The fuel flow should be leaned to approximately 50° lean of peak EGT on the key cylinder (the last one to peak, indicated by a small box surrounding the temperature reading at the top of the meter). Ignore "Too Lean" notification.

10. Normalize vs. Absolute button.

After setting cruise power and mixture, many pilots press the "Normalize" button and consider the task complete. The problem with this is that the actual EGT readings are now hidden from view and the pilot can not cross-check these values to see if what they've done is correct. Press the absolute button instead. Proper lean of peak cruise power EGTs on the normally aspirated SR22 engine should fall within a range between 1420° and 1475°. If an EGT is settling close to 1500°, then either the fuel flow has been set too close to peak EGT (see #8), or some other mechanical issue is present. Specific EGT values are not as important as their margin from peak,

however we know from experience that the SR22 engine typically shows peak EGTs in the 1500° - 1525° range.

11. Gradually pushing the mixture forward throughout the descent.

This is another common error where the pilot slowly increases the fuel flow throughout the descent, without adjusting the power lever. On the descent, there's nothing necessarily wrong with leaving the power lever positioned where it was during cruise, but many forget that as the plane descends, the manifold pressure increases, too. The result is an increasingly higher power setting with a fuel flow approaching peak EGT levels and subsequent rises in internal cylinder head temperatures (CHT) and pressures. See data plot graph below for an example of what this looks like. On the descent, simply leave the mixture alone until either the engine runs rough, or when performing the Before Landing checklist. In either case, bring the mixture full-forward.

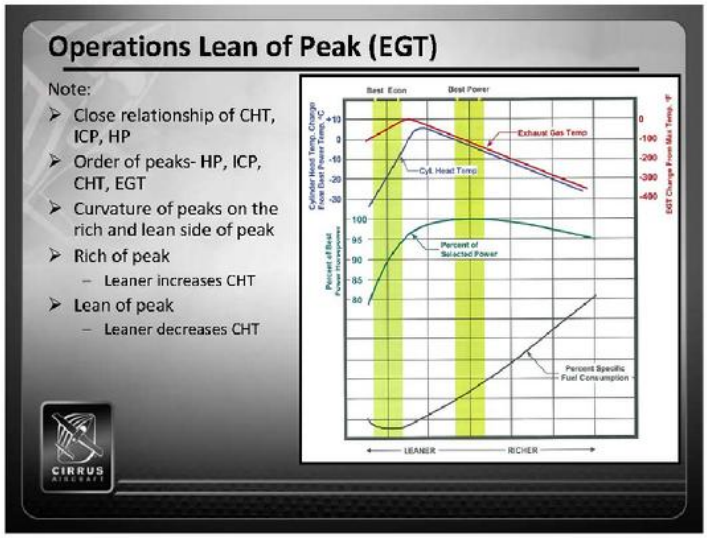
12. Turning the boost pump off after landing.

The primary purpose of the electric boost pump in the SR22 is suppression of fuel vapor in the fuel system. After landing, the engine compartment no longer receives the cooling air flow it enjoyed during flight and the temperature can rise quickly. If the boost pump is turned off too soon after clearing the runway, the engine may quit as fuel in the engine pump and lines vaporizes from the heat.

For more information…

A wealth of resources on engine management techniques and the science behind them can be found on the AirShares Elite Safety Site under the "Stewardship" tab, as well as on the systems page under the "Training" tab. Click here for access, and when prompted, enter username: *owner*, password: *safety*.

I also recommend committing some time on the ground during your next recurrent training event to go over these pointers with your instructor.



Thank you for taking the time to read this and applying this knowledge to your flying. Your safety is always a top priority at AirShares Elite, and a cooperative effort to employ best practices in operation of your shared resources benefits everyone.