

T.B.O. Myth or Legend?

Is exceeding TBO penny wise or tempting fate?

By: Larry A. Ball

An astonishing number of aircraft owners seem to believe that their engine's rated TBO (time before overhaul) is a sacred number. Exceeding TBO is like going over redline or gross weight. Should I bust TBO?

A lot of owners would rather exceed Vne before running their engines past that magic number of hours set by the engine manufacturer. This time normally runs somewhere between 1,200 and 2,000 hours, depending on the model twin Cessna involved. Some people would have you believe that going over TBO is like breaking the law, voids your insurance, causes legal ramifications, or just shouldn't be done.

It ain't necessarily so. The manufacturer's rated TBO is strictly a recommendation and has no legal or regulatory force for FAR Part 91 operations. Part 135 operators must adhere to TBO limits unless they have a waiver from the FAA, which typically requires special maintenance procedures on a timely basis. Legally, a private owner may run his engine/s as long as they are airworthy, and in many cases it is prudent to fly well beyond the official TBO.

The financial rewards for doing so can be quite large. Overhaul costs for typical twin Cessna engines run between \$12,000 for the basics up to well over \$30,000 for the GTSIO series. That amounts to as much as \$50.00 per hour. At those rates, overhauling a perfectly good running engine just because the magic number came up on the tach can be a huge financial folly. When it comes to maintaining a Cessna twin, no one wants to pour money down the drain.

A Case of Nerves

We talked to several overhaulers and found that indeed, most owners do just that. About 80% of the engines that go in for overhaul are running just fine and the only reason for them coming into the shop was that the guy in the left seat just plain got nervous.

The other side of the coin is that with a twin, you have always got another engine to get you where a safe landing can be made. Right? Well, if you read the statistics, you will find that light twins are not any safer at all, even with the redundancy of two engines. Very few pilots train to

Ok, don't get me wrong. I'm not advocating that you go right on flying your twin and totally ignore TBO numbers all together. TBOs are based on real world experience and in most cases a controlled test by the manufacturer. There is some luck involved. Proper care and operational procedures as well as frequent flying will

the point of being proficient on one engine and engine failures in a twin can be almost as bad as engine failures in a single.

There is also some input from the legal climate. If you take your old pal Fred Fazoock for a ride and the engines on your trusty twin are over TBO and you and Fred are involved in a fatal accident, the legal world would like you, or especially your estate, to believe that you were liable for Fred's death due to negligence in flying an aircraft with known worn out engines. It could be argued that that exceeding TBO reflects a general attitude of lack of care.

Just because Fred's attorney makes the argument doesn't mean that the argument will prevail or even be allowed into evidence. It's up to the judge and later the jury for the outcome and to date, this argument has not been made.

A Matter of Prudence

We have not been able to find any cases where exceeding TBO has caused a pilot legal problems. However, if you're extremely cautious and do everything a conservative attorney tells you to do, you would overhaul at TBO.

Insurance Fears

Some pilots fear that their insurance policies might not be valid if they crash with an engine or engines over TBO. We have not been able to find an insurance policy with this type of exclusion. One guy that lost a 310 had over 3,100 hours on both engines and his insurance company raised no questions about the claim, even though they were full aware of the time on the engines. Now, just for the record and to be on the safe side, dig out your insurance policy and see if there is an exclusion of coverage if you go beyond TBO.

Proceed with Caution

help in making and exceeding TBO. The question is, how do you know if you fall into the smart or lucky group?

If you are approaching TBO and your engine is running fine, should you write the big check or keep flying?

Your decision should depend on many factors, most of which have already happened. To some degree, you have already made a decision by the way you have used and maintained your engines over their lifetime, and what you know by their history.

The following is a list of major factors to consider in answering the question of “busting” TBO. We’ve listed some guidelines for determining whether your engine is a good candidate for running past TBO. A plus (+) rating means the odds are in your favor, a medium (=) rating means your in the middle ground and a minus (-) rating is a caution sign. Add up your factors and if they come out strongly positive, your engine is a candidate to safely run beyond TBO.

1. Type of Engine

Some engines are known TBO busters, some rarely make the magic number, no matter how you maintain them or how often you fly.

The overhaulers basically agreed on the following:

+ engines:

O-470-M
IO-470-D,- U,- VO
IO-520-MB
IO-550 series
LTSIO- and TSIO-520-AE

- engines:

TSIO-470 series
GTSIO-520-C, -D, -H

= engines:

All other twin Cessna engines

2. Engine Utilization

Engines that fly the most last the longest without question. The best way to get 3,000 hours out of your engines is to fly them eight hours every day. I know of a 310Q that gets flown regularly that has well over 2,200 hours on both engines and they are bone dry and use a quart of oil about every 8 hours. I remember talking with a guy that flew an older 310 every day in the desert southwest and he swore he had over 4,000 hours on one of the O-470-M engines before he got cold feet and gave in to Colonel Sanders (chickened out).

Fishing for Time

Few non-commercial pilots fly that much. The FAA says that the average twin Cessna flies about 200 hours

Your chances of beating TBO are directly related to the quality of the most recent overhaul. Major overhaul can be interpreted a number of ways that covers a vast range. Dip and ship shops are few but they are still a factor, especially if your engines have been around for a while and have only a few hours. Middle of the road shops may completely tear down the engine and

per year. The more you fly, the better your odds for making or exceeding TBO.

The other side of the coin are the “hangar queens”. You can usually forget about reaching, let alone exceeding TBO. A twin Cessna has to fly at least two hours a week to even have a chance of making TBO. Acid builds up in the oil and if it is allowed to sit for a few weeks, you end up with corrosion inside the engines.

++ engines:

More than 1000 hours per year

+ engines:

400 - 1000 hours per year

= engines:

200 - 400 hours per year

- engines:

100 - 200 hours per year

-- engines:

Less than 100 hours per year

3. Average Length of Flight

Remember, hours per day aren’t the whole story, you must also consider the length of each flight. Average flight lengths are rated as follows:

+ engines:

More than 3 hours

= engines:

1 to 3 hours

- engines:

Less than 1 hour

4. Calendar Time Since Last Overhaul

Another item that must be considered is the calendar. If the engines haven’t been done for a long time, there may be obsolete and wear prone parts involved that have since been subjects of Service Bulletins or even ADs. An example of this is the Air Melt versus the VAR crankshafts found in the 520 engines. The calendar year rating is as follows:

- engines:

More than 12 years SMOH

= engines:

4 to 12 years SMOH

+ engines:

Less than 4 years SMOH

5. Quality of the Most Recent Overhaul

reassemble it to serviceable limits with new and used serviceable parts, but, corners may have been cut. Highly rated shops do everything possible to give you back an engine as good as it can be. All parts except the crankshaft and case halves are new. All accessories are rebuilt or replaced with new. Everything can be changed except the data plate but the logs will still say the engine

has 4,000 hours total time and 0 SMOH. Factory re-manufactured engines are as close to new as you can get. Everything is set to new tolerances, you get a new data plate and a new set of logs that start at 0. New engines, due to the high cost, are not even a consideration, unless you own a Bonanza. (Continental has a new Platinum engine available for the Bonanza at a cost of over \$60,000.00). Core times are not really a factor in making TBO. If your last overhaul was a cheap service limits only job, forget beating TBO. In fact, you're lucky to even be in a position to consider it. If the last overhaul was just before you bought the airplane, check the logbooks and see who did the job. The logbooks should contain a list of parts that were replaced. How old is the crankcase? Has it ever been repaired for cracks? How many hours on the crankcase? Part of any prudent pre-purchase inspection should be a case history search of the engines. Be careful. A lot of overhauls that were accomplished to make the aircraft marketable are done on a shoe string and all kinds of corners may have been cut. You wouldn't spend a bunch of money on an airplane you were trying to unload would you?

The overhaul rating is as follows:

- ++ engines:
Factory re-manufactured
- + engines:
Factory or reputable rebuilds
- = engines:
Generic new limits overhaul
- engines:
Unknown overhaul history
- engines:
Dip and ship or cheap service limits

6. Engine Operating Technique

The way an owner operates his engines can make a big difference. Engines should be broken in like they are going to be flown. Run the engines easy for the first couple of hours and then run them just like you plan on operating them for the rest of their life. Monitor and keep all temperatures in the green. Add takeoff power slowly and smoothly using a six count. Keep your climbs shallow keeping cylinder temperatures well below the limits and minimizing stress. Pretend the throttles on turbocharged engines are eggs. If you push them too hard they'll break. Descents should be made decreasing

Oil analysis has established itself as a useful tool for analyzing the health of an engine. If you get to TBO with a pile of oil analysis sheets that show a steady predictable level of wear, you've got a persuasive argument to keep running the engine. If wear metals are beginning to increase or there are suddenly unpredictable patterns showing, you probably should be careful. We rate oil analysis this way:

- ++ engines:
Normal oil analysis reports for the life of the

manifold pressure at a rate not to exceed 1 inch per minute. Proper leaning is a must. If you have multi-probe EGT and CHT, use them to your advantage. Lean during taxi, lean to best power during climb, refuse rapid descent clearances, leave turbocharged engines lean during descent to pattern altitude or final approach fix and most of all, never slam the engines to full power from idle. We'll rate engine operation as follows:

- + engine:
Engine operated by careful, prudent, finicky and even fanatical pilot who equips his plane with six probe EGT and CHT and knows how to use them.
- engine:
Engine operated by brain dead bozo that used to drive a dump truck. If the past pilots are unknown or the plane was used as a rental, assume it was flown, at least part of the time, by one of these.
- = engines:
Everybody in between

7. Frequency of Oil Changes

The frequency of oil changes can help make or exceed TBO. The cheapest form of engine insurance is frequent oil changes. Aviation oils do not do a very good job of neutralizing acids which can build up rapidly, particularly in urban areas with lots of air pollution. Frequent oil changes get a trained pair of eyes under the cowling regularly and they may find and correct minor problems before they become major ones.

- ++ engines:
Oil changed every 25 hours
- + engines:
Oil and filter changed every 50 hours
- = engines:
Oil changed every 50 hours or four months
- engines:
Oil changed every 100 hours or six months
- engines:
Oil changed about once each year at less than 25 hours.

8. Oil Analysis

- engine
- + engines:
Normal oil analysis reports every 200 hours of operation
- = engines:
No oil analysis data available
- engines:
Recent oil analysis showing increase in wear metals.

9. Oil Consumption

Oil consumption is another indicator. High oil consumption, by itself, almost never indicates a serious problem that would call for overhaul. What is high oil consumption? One quart for each hour of flight. Oil consumption is normally related to sticky oil control rings. Other tests, such as compression, usually give us a better indicator of something going sour. Perhaps more important than absolute oil consumption is the trend in oil consumption. If it's been holding steady at a quart every three hours, that is preferable to a sudden increase from a quart every eight hours to a quart every three hours. We rate oil consumption as follows:

+ + engines:

A steady use of oil at a rate of one quart per 12 hours or better.

+ engines:

A steady use of oil at a rate of one quart per 6 to 12 hours.

= engines:

A steady use of oil at a rate of one quart every 3 to 6 hours.

- engines:

An engine using up to 1 quart each hour.

- - engines:

An engine that has recently shown a dramatic increase in oil consumption.

10. Cylinder Compression Check

Although cylinder compression checks are far from infallible, and subject to all sorts of quirks, they can be a quick, cheap indicator of an engine's health, at least in the top end. Low compression usually means there is trouble in the rings or valves and is a clear warning to inspect further before exceeding TBO. Low compression on any given cylinder does not necessarily mean you have to change that cylinder. The mechanic should determine whether the leakage is through the exhaust or intake system, or simply by the rings into the crankcase. Even the slightest leakage around a valve can be a problem, but if the valves are tight, low compression due solely to ring leakage may be acceptable. Continental Service Bulletin M84-15 covers cylinder leakage tests. Using a master = engines:

All of the others in between.

12. Engine Repair History

The repair history of any given engine is a clear indicator to the life of the engine. If you have a pair of engines that have made TBO with trouble-free operation, chances are that they will continue this pattern well beyond TBO.

If your engine has been humming away without a glitch since new or overhauled, give yourself a + +. Rely

on personal experience rather than hear-say from the previous owner or engine logs. They both can lie. If your engine has been relatively maintenance free with only minor repairs, give yourself a +. If your engine has been a chronic trouble maker, give yourself a -. All other cases fall into the = category.

orifice assembly tool from Borroughs, P/N 646953, as a comparison, cylinder pressures can be as low as 59/80.

We rate compression checks as follows:

+ engines:

All cylinders 70/80 or better.

= engines:

All cylinders 60 to 70/80.

- engines:

One or more cylinders below 59/80

- - engines:

One or more cylinders below 59/80 with leaky valves.

11. Instrument Readings

The instrument panel is a window to your engine's operation and health. Just because they put the engine instruments such as, oil pressure, oil temperature, fuel flow, cylinder head temperature, exhaust gas temperature and turbo inlet temperature away from the primary flight instruments, doesn't mean you leave them out of your instrument scan. A healthy engine, at cruise, will have oil pressure in the high green, CHT and oil temperature in the low green and the EGT will be relatively even on all cylinders. Here is an example: You have a 6 probe EGT/CHT system and suddenly see an increase in fuel flow along with one of the cylinders showing a dramatic decrease in temperature. Most of the time this would indicate that the tiny orifice in the fuel injector is plugged for that particular cylinder. Why the increase in fuel flow? The fuel flow gage is simply a sensitive fuel pressure gage taken from the spider valve that distributes fuel to all six cylinders. When one cylinder stops getting fuel, the pressure will increase by up to 18% because the same amount of fuel is now going to only five cylinders. The cylinder not getting sufficient fuel will run cooler than the rest. Some engines run hotter than others. We rate instrument indications as follows:

+ engines:

Temperatures consistently in the low/middle green, oil pressure in the high green and EGT spread low.

- engines:

Temperatures often at or near red line and large EGT spreads.

on personal experience rather than hear-say from the previous owner or engine logs. They both can lie. If your engine has been relatively maintenance free with only minor repairs, give yourself a +. If your engine has been a chronic trouble maker, give yourself a -. All other cases fall into the = category.

13. Preventive Maintenance History

Beyond frequent oil changes, frequent preventive maintenance almost always helps stretch engine life, perhaps to TBO and beyond. In fact, if you're serious

about TBO busting, you should have started doing preventative maintenance from the very beginning. Follow an example of 135 operators. Due to increased strict inspections at timely intervals, along with oil analysis, regular borescope exams, cylinder changes as necessary and detailed phase checks every 50 and 100 hours, they can sometimes get TBO extensions.

Rate your maintenance as follows: If you have been doing something similar to the above, give yourself a +.

If you're the type of person that changes oil every 100 hours whether it needs it or not and are constantly bugging your mechanic about cutting cost saving corners on every inspection, give yourself a -. All others fall into the = category.

14. Condition of Accessories

Accessories on an engine play a very important part in the life of that engine. Vacuum pumps, magnetos, alternators, turbochargers and even things as small as engine baffling are extremely important to engine life. A cross-firing magneto, even for a brief time, on a GTSIO is hazardous to its health. A gear driven alternator drive coupling failure puts lots of rubbery gook through the oil pump and oil system. This can plug oil pickup screens and filters. Dry vacuum pumps are notorious for failing well before TBO. They're better than they were but chances of getting engine TBO out of a dry pump are few. All accessories should be rebuilt at each engine overhaul. Rate your engines with a +, =, or - based on the condition of the accessories and how close they are to their rated lifetimes.

For those who insist there's some art as well as science to engine trouble shooting, we've added this last category, how does the engine sound and feel? Does it have a good healthy purr? Is it smooth? Do you hear any mysterious clatter or clunks (not just when you begin a long trip over water)? If you think something is just not right, don't rely on your intuition, have your mechanic take a look, listen or even go for a ride with you.

Because TBO busting is so psychologically precarious, your engines should sound and feel good if you're going to fly them around with over 2,000 hours on the meter. If that little voice in your head that whispers, "You're beyond TBO," is joined by a cacophonous chorus from either engine, the money you save may not justify the mental aggravation. You have to rate yourself on this one. Give yourself a +, = or - based both on your and your mechanic's evaluation.

Well, there you have it: 14 factors to consider in your decision to go beyond TBO. Because of the ++ rating five categories, the perfect score is 19. The worse possible score is also minus 19.

Ok, guys and gals, add them up. If your total is anywhere in the minus category, you probably better forget about going past TBO. Be thankful you made it this far and write the big check.

If your total is between 0 and + 6, you might consider going beyond TBO with careful maintenance, oil analysis and prudent inspections. How nervous is your copilot? Do you take extended trips over mountains or water? You might even ask your favorite attorney.

If your score is plus seven to plus 12, you're a reasonable candidate to go beyond TBO. Ask yourself all of the important questions again though, just to make sure.

If your score is + 13 or higher, I see no reason why you shouldn't keep flying "Old Yeller's" engines right on into the 21st century. Another consideration that is extremely important: If you bust TBO and anytime after have a catastrophic failure that leaves you without a core for overhaul, all of the money you could have possibly saved just went down that same drain mentioned earlier.

If you have any questions, you might want to talk to your trusted mechanic, talk it over with your copilot and attend one of our systems and operational procedures seminars.

Not only will you gain in knowledge but you will have the opportunity to talk to people with first hand experience along with other owners that fly engines and aircraft just like yours.

If you take your twin Cessna for granted, you may test your best piloting skills. Good Luck and most of all, Good Flying.