



COPA

TBO, just what is that?

by ROGER WHITTIER

We often hear the term "TBO" in aviation. What does it mean? How is it calculated? Is it mandatory? The acronym TBO stands for **Time Between Overhaul**. You will not find a clear definition in the FARs of TBO. Let's dissect what is going on.

For an engine to be installed in a certified aircraft, it must be approved. It is certified to meet the requirements of the Federal Aviation Regulations (FARs) outlined in CFR, Part 33, which are quite detailed and lengthy. These requirements establish standards that the engine designer must meet for certification. They go into great detail for a seemingly endless list of issues – Foreign Object Damage (FOD) ingestion, vibration, oil temps, detonation margin and much more. In fact, that short list doesn't even scratch the surface (literally) of the test requirements. In the process, it must be demonstrated to the FAA that the engine passes all requirements. This is typically done by running the engine on a stand where testers can control all inputs and adjust the environment as necessary to maintain the required harsh conditions.

The engine test center at the Continental factory is equipped to monitor and control the engine very precisely. The airflow is controlled so they can test cylinder life at elevated temperatures, and the oil temperature is controlled, as are inlet air temps, etc. The engine is tested in very punishing conditions; those you would not be comfortable running your engine at. Oil temperature is maintained at redline for the entire test (240°F). Cylinder(s) are maintained at 460 degrees for the entire test period – wow! It cannot fail, detonate, or crack at those temperatures or the part must be redesigned and the test starts over.

The FARs dictate a test protocol that runs the engine at very specific operating parameters for 150 hours. Without reviewing that test, suffice to say, it is punishing and has periods of operation at different power levels (often at 100 percent power, better known as maximum continuous power). The engine is then torn down and inspected. All parts in an engine have tolerances. There is the initial part dimensions (this includes the plus or minus tolerances of the engineering drawing). There is also the "Service Limit" size. These are the dimensions a used part can degrade to and still be utilized during an overhaul; in other words, it is allowed to wear to this point and still be reused. No part in the inspection phase at this teardown can be outside the service limit size – the wear on hard parts like crankshafts, camshafts, etc., must not exceed the serviceable limits. The engine is reassembled and

run with the same protocol for another 150 hours, and then inspected again to service limits. Rinse and repeat multiple times.

So how is TBO derived? The engine is not run to failure nor is it even run to the proposed TBO. Working with the Aircraft Certification Office (ACO), a TBO that is based on test results and field experience is determined. It does not mean your engine, in the case of our CMI 360/550 family of engines, will go to 2,000 hours. It also does not mean it won't easily and safely exceed TBO. That is wholly dependent on your operation and maintenance over the life of the engine, and some would say a little luck.

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When an engine gets to TBO, what must you do? It depends on which set of regulations you are operating your aircraft under. This may also vary by regulatory agencies – EASA or CASA, for example, have different interpretations on this than the FAA. An N-registered aircraft operated under Part 91 regulations is only under the limitations that it was certified to. In the case of the engines on our Cirrus aircraft, it must be "airworthy" and that is decided when an A&P with Inspection Authority signs off the airplane as airworthy. Hours do not matter; of course this means it can't be making metal, it passes compression tests as outlined in CMI SB03-3, etc. If you operate to Part 135 or other higher standard regulations, this option may not be available to you, but in those cases there is a process based on data to request a TBO extension. Often, high-time fleet operators do this and are routinely granted extensions with the appropriate data. As you can see, even the FAA is not stuck rigidly on TBO.

The highest time engine in a Cirrus aircraft before overhaul that I am aware of was owned by well-known COPA Member and Safety Guru, Rick Beach, who operated it to 3,517 hours. At that point, the main number two bearing started to make metal (disintegrate) when he prudently (and immediately, I might add) overhauled it. He did, however, have some cylinder work done at around 2,200 hours. He has posted about this on the forums, but it is a great example of running the engine well beyond TBO safely and economically.

TBO is a calculated number. With proper operation and maintenance, an engine should easily meet or exceed TBO. It is not a mandatory stop sign. As always, you should talk to your mechanic about how to comfortably operate beyond TBO. ☺