

The properly timed sequence of valve opening and closing is essential to efficient and reliable engine operation. This publication provides insight into potential troubleshooting techniques to help ensure proper timing. The procedures laid out herein to help prevent valve sticking will also reduce the probability of additional engine damage. These procedures may be reduced to relatively simple terms: The maintenance and operational procedures necessary to avoid sticking valves are those that keep the engine clean internally and which cause it to run within proper operating temperature ranges.

The space between the continuously moving valve stem and its stationary valve guide is critical. Changes in valve-to-guide clearance can occur during the course of engine operation. The amount of clearance can be affected by high temperature, engine cleanliness, and extended periods of engine inactivity. In other words, a sticking or broken valve may result from a lack of proper maintenance or environmental factors. It is possible to promote valve sticking, and it is also possible to engage in actions to reduce or eliminate the possibility of this issue. These actions will affect engine cooling, fuel management, and internal engine cleanliness.

Operational and Maintenance Procedures to Avoid Sticking Valves

Field experience has shown that engine oil contamination increases the possibility of sticking and/or stuck valves. To prevent valve sticking and to reduce the possibility of damage, all exhaust valve guides should be cleaned of any carbon, varnish or other contamination buildup. This is accomplished by reaming the guides to their original size as specified in Lycoming Publication SSP 1776, Table of Limits. The latest revision of Lycoming Service Instruction 1425 provides recommendations to reduce the possibility of valve sticking. In particular, Part III of the instruction gives a procedure for reaming valve guides that can be accomplished without removing the engine from the aircraft or the cylinders from the engine.

Engine cleanliness is a primary consideration that is affected by various maintenance and operational procedures. Proper filter maintenance is one such item. The induction air filter is the first line of defense in keeping dirt and abrasives from entering the engine. To prevent dirt from entering the engine, the filter must form a good seal with the filter holder, and the induction system should be free of air leaks. The air filter should be cleaned or changed as recommended by the aircraft manufacturer. In extremely dusty conditions, a filter change could be necessary as frequently as every few hours of operation.

The second line of defense against dirt and abrasives is the full-flow oil filter that is standard with most Lycoming engines now being produced. Older engines were manufactured with a pressure screen, but may be converted to a full-flow filter for more effective cleaning of the oil. Lycoming Service Publication SSP-885-2 provides information and instructions needed for this conversion.

Another contributor to a variety of engine problems, including valve sticking, is frequent long periods of inactivity. An engine should be flown regularly to stay in tiptop condition. The oil in the sump collects residue from combustion such as moisture, acid and lead sludge. Flying the aircraft tends to heat the oil enough to vaporize the moisture and help eliminate some of these contaminants, but an engine that is not flown will collect moisture, acids and gums which may contribute to corrosion and to valve-train problems. In addition to regular operation of the engine, changing the oil will also help eliminate these contaminants from the engine. Lycoming Service Bulletin No. 480 makes these recommendations for engines operating under normal (non-dusty) conditions:

- 50-hour interval oil change and filter replacement for all engines using a full-flow filtration system.
- 25-hour interval oil change and screen cleaning for all engines employing a pressure-screen system.
- A total of four months maximum between oil changes for either of the systems discussed under a. and b., even if the engine is not flown.

Reports from aircraft owners indicate that engines subjected to frequent oil change intervals are more likely to result in trouble-free operation through TBO.

Preventing the buildup of contaminants is just as important as eliminating those that do form. Avoiding long periods of ground operation is a vital step since moisture can enter the breather, but will not vaporize when the oil is not heated to normal operating temperatures. Ground running also involves a slightly rich mixture which contributes to the formation of lead sludge in the oil. During flight, the deposit of lead sludge in the oil can be minimized by proper leaning.

Although some excess fuel is required for engine cooling during high-power operation, proper leaning at cruise-power settings will promote complete burning of the fuel and, therefore, a minimum of lead sludge deposited in the oil. This is important since lead sludge is not filtered out, but is removed by changing the oil. The Airframe manufacturer's recommendations and limitations for leaning should be observed, but be aware that when permitted by the Pilot's Operating Handbook, leaning to peak EGT at cruise-power settings will produce complete burning of the fuel/air mixture for best economy and reduction of combustion-related contaminants.

The final factor affecting potential valve sticking is engine operating temperature. Some operating procedures already discussed also have an effect on engine temperature. Prolonged engine ground run-up at high-power settings, for example, can cause engine overheating or hot spots since cooling airflow is not always adequate when the aircraft is stationary.

It must be emphasized that baffles designed to direct cooling air over the cylinders must be maintained in good condition. They play an extremely important role in regulating engine operating temperature. If these baffles deteriorate or are installed so that cooling air is not adequately contained and directed, hot spots which promote a lead or carbon buildup may occur. During hot weather in particular, those baffles or ducts that direct cooling air through the oil cooler must also be maintained in good condition.

The pilot, as well as maintenance personnel, will play an important role in ensuring that engine operating temperatures do not promote valve sticking. As mentioned earlier, ground running far in excess of the time necessary for engine warm-up should be avoided. Also consider that continuous operation at very low aircraft speeds that may not generate the most efficient flow of cooling air over the engine. This lack of effective cooling air may cause some areas of the engine to be excessively hot, and therefore have an effect on any contaminants that are in the oil. The formation of deposits is promoted, with the exhaust valve guide area the most likely to be affected. The result of these deposits may be a stuck or sticking valve.

The other end of the spectrum controllable by the pilot is excessively rapid cooldown of an engine that has been running at normal operating temperatures. Lycoming engines are made with various metals that expand and contract at different rates when exposed to heat or cold. It is poor technique to "chop" the power from cruise or higher power settings to idle and then start a rapid letdown which develops excessive cooling airflow over the engine. It is always best to reduce power in increments so that engine temperature changes will occur gradually. It is also beneficial to continue the engine cooling process after landing by ensuring that several minutes of engine operation at 800 to 1200 RPM are allowed before shutdown.

Finally, we address techniques to help you identify a possible stuck or sticking valve by diligently investigating certain key indicators. An intermittent hesitation or miss in the engine may be an indication that carbon or other similar contaminants have built up inside the valve guide causing the valve stem to drag instead of moving freely. These contaminants should be removed by reaming the guide to the size specified in the Lycoming Table of Limits (SSP 1776). The procedure to be used when reaming to remove valve guide deposit buildup is found in Lycoming Service Instruction 1425. This valve guide reaming procedure restores valve stem to guide running clearance and can be accomplished without removing the engine from the aircraft.

Refer to the latest revisions of the following Lycoming documents for additional information:

SSP-885	Service Instruction No. 1094
Service Bulletin No. 480	Service Instruction No. 1425
SSP-1776	Service Letter No. L197
Service Bulletin No. 388	