

Stuck Valves

A stuck valve usually occurs when the engine is first started and is often identified by an intermittent hesitation, or miss, in engine speed. We call this "morning sickness". Flying the airplane with a stuck valve increases the risk of engine damage. The repair criteria should be to un-stick the valve as quickly as possible.

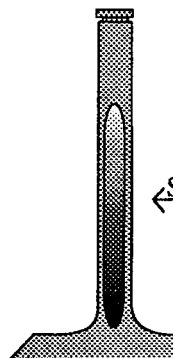
The engine's operating environment and design causes valves to stick. Many factors influence this environment, including: engine temperature, engine design, engine installation, baffle condition, operational technique, oil, fuel, and frequency of oil changes. Even ambient temperatures have a great influence on valve sticking. Valves stick more in the hot summer months than in the cold winter months.

Lycoming engines suffer more frequent exhaust valve sticking than Continental engines. This is not due to the quality of the pilots flying Lycoming engines versus those using Continental engines. The difference in tendency has to do with how design differences between Lycoming engines and Continental engines influence the valve operating environment.

High temperatures in the exhaust valve guide oxidizes oil and forms carbon deposits on the valve guide and these deposits cause the valve to stick. The most frequent reason for elevated valve temperatures is valve leakage. All of the combustion gas must pass around the valve face as it goes



Figure 2-13 Bent push rod and housing. Example of the elasticity of the valve train in the presence of a stuck valve.



out the exhaust port. The large heat-absorbing surface of the exhaust valve face must conduct heat away from its surface. A valve that is not contacting the seat properly cannot conduct as much heat into the cylinder head as a valve with good seating. Elevated valve stem temperatures may then cause the valve to stick. The pilot will not notice a leaking valve but usually notices a stuck valve.

Lycoming valve stems operate at higher temperatures than Continental valves stems. Continental engines use solid exhaust valves whereas Lycoming engines use sodium cooled exhaust valves. The sodium in the Lycoming valve melts at 97.5°C and conducts heat from the head into the valve stem and then into the cylinder through the valve guide. Figure 4-3 in Chapter 4 shows that the Lycoming valve stem normally operates 100°F hotter than the Continental valve stem. The higher temperatures create an environment that is more susceptible to valve sticking. Any engine, if operated at an excessive temperature, creates excessive stem and guide temperatures.

Most of the heat conducted from the head of the Lycoming exhaust valve goes out through the valve stem into the cylinder head fins. The Lycoming guide boss allows 5% of the guide to extend past the end of the boss and protrude into the exhaust port. This extended portion of the guide does not make contact with the guide boss. This reduces the ability of the guide to conduct heat from the stem into the boss. The protruding guide also absorbs heat from the flow of exhaust gas. Because of the high temperatures and combustion deposits on the exhaust valve stem, this area of the

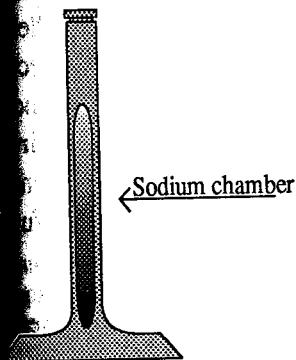


Figure 2-14 Lycoming exhaust valve showing sodium chamber. The hollow space in the valve is half filled with sodium, which liquefies at valve temperature and sloshes back and forth in the valve as the valve moves. Sodium increases the heat conductivity from the exposed surface of the valve to the stem and so draws heat from the head.

guide bellmouths or gets bigger. This increases the clearance between the guide and the stem and allows combustion products and heat to travel up the valve stem. These combustion products create lead deposits and acids which increase the corrosive environment.

Lycoming valves also stick because of corrosion buildup on the valve stem. Corrosion increases the dimensions of the part, thereby reducing the valve stem-to-guide clearance. The high stem temperatures, combined with a design which allows more combustion products into the guide bore, create a corrosive environment which is seldom seen on Continental engines.

Lycoming TIO-541 engines installed in the Beechcraft Duke use an oil-cooled exhaust guide. Cooling oil circulates in a groove between the exhaust guide and the guide boss. If this groove cokes up with oxidized oil and becomes blocked, the exhaust guide and valve overheat and stick. If you have a stuck exhaust guide on this engine, be sure to check the oil passage by blowing compressed air through the oil fitting in the cylinder head.

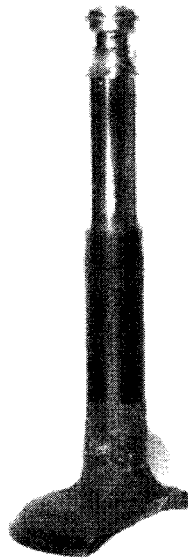


Figure 2-15 Lycoming sodium cooled valve. Black line from oxidized oil indicates a temperature gradient and the upper boundary of the sodium chamber. Continental valves do not show this temperature gradient.

Proper valve guide cooling, valve rotators, proper metering of oil through close valve-to-guide clearances are engineering elements which reduce the tendency for valve sticking. Environmental influences that create valve sticking are: high temperatures, dirty oil, high lead content fuels, hot engine shut-downs, and poor engine baffling. The repair shops that overhaul or repair your engine cannot change the engineering and have little control over the environment in which your engine operates. From the standpoint of cylinder repairs, all that can be done is to use the correct parts, dimensionally match the parts carefully, and control the surface finish of the guide. The aircraft repair shop can influence the environment by checking engine health, precise timing, careful

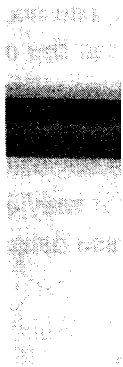


Figure 2-16 Note the push rod becoming sideways when the cam follower

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baffle inspections, and by recommending more frequent oil changes.

Continental engine design is more resistant to valve sticking. We see more of a tendency for the intake valve to stick on Continental engines in the O-200, O-300 series. A stuck intake valve disrupts the breathing of the entire induction system. The power loss results in a forced landing.

Do not use Marvel Mystery Oil or other solvents to un-stick a valve. Solvents may un-stick the valve in time but not immediately. Eventually the valve may un-stick, but not before your camshaft lobes have been damaged. Solvent treatments dissolve the outer deposit layers in the guide boss and temporarily un-stick the valve. The remaining deposits push the valve over to the opposite side of the guide and cause rapid, uneven guide wear. The valve stem may stick or it may cause rapid guide wear where the stem is forced against the guide material opposite of the deposit buildup.

Each time the rocker arm tries to open that stuck valve, you risk catastrophic engine damage. The rocker arm tries to push the valve open. With a stuck valve, the valve doesn't want to move. Tremendous valve train forces develop as the camshaft lobe tries to force the valve open. When operating normally, the highest loaded surfaces in the engine are the camshaft follower and lobe, and additional loading may induce failure. Damage to these surfaces occurs because of

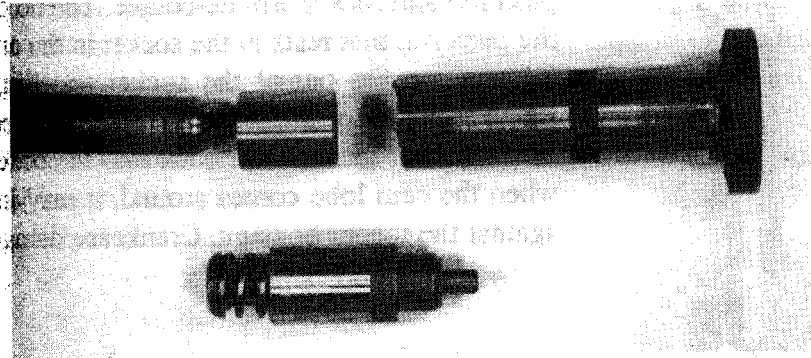


Figure 2-16 Notice chips missing from top of cam follower. When the valve fails to close the push rod becomes loose and the socket comes out of the follower. If the socket cocks sideways when the cam lobe comes around for the next valve event, the socket jams against the cam follower.