Valve Care

Good habits keep oil flowing smoothly

BY STEVE ELLS

THE HUMAN HEART IS similar to a reciprocating airplane engine in one way; both use valves to control vital fluid pressures. Both Lycoming and Continental Motors engines use simple spring-loaded ball-and-seat type valves to control the engine oil pressure. In addition to the simple oil pressure relief valve there's at least one more oil system valve in every oil system designed to protect components and prevent oil cooler damage.

All oil pumps consist of two meshed gears that revolve inside the pump housing — one gear is driven, and it in turn drives the second gear. As the gears rotate, oil drawn from the sump is forced around the outside of the gears. Before it's circulated to the engine one of these valves comes into play.

High-pressure oil from the pressure side of the pump flows through either the oil screen or through the engine oil filter before the oil goes on to the engine.

Lycoming oil pump

Both oil screen assemblies and oil filters have filter bypass valves. What does a filter bypass valve do? It keeps oil flowing to the engine should the filter or screen become clogged by oil-borne contaminants. The oil-borne contaminants that clog engine filters and screens are almost always caused by the failure of internal engine parts such as the aluminum wrist pin plugs or main or connecting rod bearings.

When the filter or screen becomes clogged it's a sure thing that the engine will fail within a very short time due to the loss of oil cooling and lubricity at critical points in the engine.

A few minutes of operation may still be possible after the bypass valve opens and unfiltered (and contaminated) oil continues to circulate until engine failure.

The get-on-the-ground-now sign of impending engine failure is a dropping oil pressure and a rapidly rising oil temperature.

Hopefully none of us will ever experience an engine failure, but it's almost a sure bet that a number of pilots have unknowingly caused a filter (or screen) bypass valve to open because of a full-throttle-type engine start or the lack of engine preheating.

Continental says to preheat when ambient air temperatures drop below 20 degrees Fahrenheit. Lycoming says to preheat anytime the temperatures drop below 10 degrees F except for the O-320-H series and the O/LO-360-E series engines; the preheat trigger is 20 degrees F for these engines.

Many experienced pilots believe these limits are too low and start preheating whenever outside air temperatures are at 30 or 40 degrees F.

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OIL-PRESSURE RELIEF VALVES

The variation in the rotational speed of the oil pump from idling to full throttle and the fluctuation of viscosity of the oil because of temperature changes are compensated for by the tension on the pressure relief valve spring.

After the oil passes through the filter or screen the oil pressure relief valve controls the maximum oil pressure. Oil pumps are always oversized — this ensures that there will always be a more-than adequate supply of oil pressure and volume in all conditions. The spring-loaded relief valve can be likened to a hole in the main oil galley (tube) that is automatically opened to vent off too-high pressures. The "hole" opens when the oil pressure pushing against the "oil" side of a round steel ball exceeds the pressure applied to the other side of the ball by a spring. Engine oil pressure is adjusted by changing the spring pressure.

Lycoming wants an oil pressure of 25 psi at idle; Continental wants 10 psi. Low oil pressures may be caused by internal engine wear or by channeling off the oil-relief valve seat. These seats can be refaced in the engine without too much trouble.

Oil-pressure relief valves rarely cause any trouble. Occasionally a piece of debris gets caught between the ball and the seat; the symptom for this malady is lower-than-normal oil pressure. But unlike a major engine or oil system failure, the oil temperature will stay steady instead of rising. If this should happen, reduce power and land as soon as possible and get the relief valve cleaned.

Lycoming oil pressure relief valve

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Vernatherm

PREHEATING AND OIL COOLERS

The oil cooler used on the 150-hp Lycoming O-320 series engine must be capable of withstanding continuous pressures of 150 pounds per square inch and a proof pressure of a minimum of 400 psi. These numbers are far above anything pilots will ever see on an instrument panel gauge.

Yet oil coolers still burst — and this is almost always caused by extreme high-pressure spikes caused by failure to preheat the engine and oil cooler during cold weather.

Oil coolers are also equipped with valves; these valves, which operate much like the thermostat that controls coolant flow through an automobile radiator, automatically control oil flow through the cooler. At lower temperatures this temperature-controlled valve is retracted and cold oil bypasses the cooler. When the oil temperature increases to approximately 150 degrees F, the valve assembly — often called a Vernatherm after the manufacturer's name — will lengthen toward a tapered seat. At 180 to 185 degrees F the valve will be fully seated — sealing the bypass route and routing all the oil through the cooler.

Another feature of the Vernatherm valve is a spring that assists the bulb in seating the valve end. This spring has one other important job. In the event of an oil-pressure spike — a high-pressure surge — this spring will be compressed to open the bypass route to protect the cooler. It's critical to always preheat the oil cooler. This is a bigger problem on Lycoming engines where the coolers are most often remotely mounted.

If the cooler hasn't been preheated, the Vernatherm valve and seat may be damaged. As the engine warms up, the Vernatherm valve senses warm oil temperatures and will lengthen to seal against the bypass seat. This routes the warm engine oil to the cooler. If the cooler hasn't been preheated, this warm oil will bump up against exceedingly viscous cold oil in the cooler. At very low temperatures, the oil in the cooler will be extremely thick. This causes a pressure spike that exceeds the spring pressure against the valve of the Vernatherm, and the bypass path will open. This immediately drops the oil pressure and the valve then slams shut against the seat. This jack-hammering of the oil pressure at the cooler will cause the valve to hammer against the seat, and can also cause damage to the oil cooler. In extreme cases the cooler will burst.

What's the takeaway from all of this? Learn how to start your aero engine gradually; high rpm starts are one of the most destructive things you can do to an engine. Preheat the engine and the oil cooler when it gets cold. Consider using multi-viscosity oils during winter months; they aren't anywhere near as viscous as straight-weight oils. EAA

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