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AIRFRAME AND POWERPLANT

THE UNFILTERED TRUTH

AOPA PILOT

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Why you need an oil filter

In the beginning there were dinosaurs and prehistoric flora and fauna. There were no airplanes. Then came extinction and climatic change or vice versa. Now 65 million years later the modern world lives — cooks, heats, drives, boats, flies, and blows lawn clippings around — off the legacy of our prehistoric friends.

Both avgas and oil formulations have changed a great deal since Orville wobbled skyward more than 100 years ago — the Wrights had to use 50-octane gasoline obtained from a nearby marina. Oil filtration systems have also changed — but not so quickly. Champion introduced its first spin-on oil filter in 1974.

Not too long ago most of the engines shipped by Teledyne Continental Motors (TCM) and Textron Lycoming were equipped with rudimentary screens instead of spin-on filters. Mechanics jokingly admit that these screens capture metal — and most of the metal chunks captured are large enough to still be inscribed with part numbers! Yet testing has revealed that these screens are better than nothing. But they're nowhere near as efficient as spin-on filters.

The Airwolf oil filter tests

Airwolf Filter Corp. manufactures and sells products related to oil systems. The company is well known for its firewall-mounted spin-on oil filter adapters. John Kochy is the senior tech advisor for Airwolf. Late in the 1990s Kochy contracted with the Fluid Power Institute at the Milwaukee School of Engineering to test the efficiency of various aviation oil filtering systems. These tests were conducted using an ISO-4752 test standard. Additional, more comprehensive beta ratio

tests were also run — these tests measured the number and size of the particles that were introduced into the system and compared that data with the size and number of particles that exited the system being tested. This resulted in the efficiency of the system and, Kochy believes, the true measure of the filter's ability to protect the engine.

There are two ways to interpret the results. A nominal rating — which makes each system sound very efficient — describes system efficiency based on the smallest particle the system will capture. If the system is able to capture one particle that's 5 microns in size, its nominal rating is 5 microns.

An absolute rating — which the Fluid Power Institute says is the only realistic test of filter efficiency — of 5 microns would signify that the filter had captured 75 percent of the 5-micron-size particles that flowed into the filter.

Test results showed that the spin-on filter tested was far more efficient — it earned a nominal rating of approximately 35 microns — than either the TCM or Lycoming screens. The best the screens could do was 60-percent efficiency on 80-micron particles. Of much more importance was the fact that the filter — in this case a short Champion off-the-shelf spin on — captured more than nine times the amount of dirt than the Lycoming screen did and 13 times the amount of dirt the TCM screen did during the three-hour beta ratio test. The screens have almost no dirt-holding capacity. Since there are seven to 12 gallons of oil per minute circulating through the average engine at cruise power, dirt capture is critically important.

A word about microns

A micron, which as a term has been replaced by micrometer (m), is one-millionth of a meter. A meter is 39.3701 inches, so 35 microns is equivalent to one-thousandth (0.001) of an inch; 80 microns is equivalent to three-thousandths (0.003) of an inch. The average human hair is from 50 to 100 microns in diameter, so we're not talking about large particles. It would be easy to think that two-thousandths (0.002) of an inch couldn't make that much difference, but even if that were true (it isn't) filters have additional advantages over screens.

Inside each spin-on filter is a long length of pleated material — it looks a lot like thin cardboard — that the oil passes through before flowing on to protect the engine. This material is treated with an acid neutralizer. The filter also has a flow-back valve that prevents oil from flowing out of the filter when the engine is not running. This lessens the time it takes to start circulating oil upon engine start-up. Screens don't have either of these improvements.

The TCM oil-filter-adapter AD

Screens used on small four-cylinder TCM engines are inside a housing that is bolted to the engine accessory case — almost all other TCM oil screens are part of an assembly that screws down into a cavity on the right-rear corner of the engine. TCM screens consist of a sturdy folded metal mesh that is captured at both ends by lipped caps — the top cap is mounted on a center shaft by a bolt — removing the bolt permits cap and screen removal so the screen can be better inspected and cleaned. The TCM spin-on oil filter adapter replaces the screen and screws down into the same cavity that held the screen assembly. The adapter is held in place by torquing down a jam-type nut. The spin-on oil filter is then screwed on a flanged pad at the opposite end of the adapter.

It's critical that installers have access to the special wrench (or a 2-and-one-eighth-inch crows foot) to apply 50 to 60 foot pounds of torque to the jam nut during initial installation. If the proper torque isn't applied to the jam nut, the weight of the oil-filled filter combined with normal vibrations will soon cause thread damage to the adapter. In a few cases maintenance practices have been so mindless that the threads got in bad enough shape that the adapter was blown completely out of the engine. The potential for thread damage can occur on adapters installed in TCM 346-, 360-, 470-, 520-, and 550-series engines. Cessna Airworthiness Directive (AD) 96-12-22 was issued calling for an initial inspection of the adapter threads and jam nut torque. The AD also requires repetitive inspections to detect looseness. Although the AD doesn't require it for some reason, Cessna — in Service Bulletin 93-1R1 — advised adapter users to remove the adapter-mounted filter bypass valve, plug the resulting hole, and then use only oil filters with integral bypass valves on the modified adapters. TCM — in SB 94-2 — advised of an improved filter-mounting stud. Some shops believe these adapters should be retired. New TCM engines incorporated spin-on filter-mounting pads that are part of the oil pump assemblies, thus eliminating the potential for adapter problems.

F&M Enterprises, of Borger, Texas, manufactures and sells oil filter adapters that are approved by supplemental type certificate (STC) for almost all four- and six-cylinder TCM engines. According to F&M, installation is quick — the company quotes one hour — and can be done without having to purchase any special tools.

Lycoming engine filter adapters

Lycoming Special Service Publication (SSP) 885-1 — titled "Engine Mounted Oil Filter Kits and Replacement Filters" — spells out Lycoming instructions and part numbers for replacing oil-screen housing assemblies with spin-on filter adapters. As in the smaller TCM engines, Lycoming screens are within a housing that's mounted on the engine accessory case. The Lycoming filter

adapters utilize the same oil-temperature sender and oil-cooler-temperature control valve (Vernatherm) as the original screen assembly. The Lycoming adapter assembly is available from large aviation-parts houses or from engine shops.

An almost identical Lycoming-style adapter is manufactured and sold by Niagara Air Parts, of Niagara Falls, New York. It's approved for installation on almost all Lycoming engines and the price is most reasonable.

The other aftermarket manufacturer of engine-mounted Lycoming-style adapters is B&C Specialty Products, of Newton, Kansas. Bill Bainbridge and his staff produce a beautifully machined adapter from a solid billet of aluminum. Not only does the B&C adapter win the most points for appearance, but also B&C has created solutions for most fitting and installation problems.

There are two other systems that are adaptable to Lycoming engine installations — these systems can be installed on virtually all GA engines — the Airwolf system and the Aviation Development Corp. (ADC) Oberg system. Portions of both systems mount on the firewall. Engine-mounted adapters facilitate the installation of a set of flexible hoses to carry hot oil to and fro. The Airwolf firewall-mounted spin-on oil filter adapter has one compelling advantage over every other system — the adapter is usually installed so that as the filter is unscrewed all the oil stays in the filter. Big deal, you say. It is a big deal because almost all engine-mounted filters are oriented so that some oil spills out of the filter down onto the engine and engine compartment when the filter is unscrewed for removal. These spills are a giant pain because they create an almost unavoidable mess, and that's just no fun.

There are ways to lessen the amount of oil that's spilled. One that sometimes works is to take a sharp awl and punch a hole in the filter can. The point is to vent the can during the oil change, so punch the hole on the top side, halfway down the length of the can. Then walk away for a few hours or overnight. The can should be empty in a few hours and then can be removed without major spillage. The other common method is to build a cardboard or sheet-metal funnel or gutter and position it below the can as it is unscrewed. In my experience this works pretty well for some filters but is a total flop when trying to remove many other filters.

The other firewall-mounted system — the ADC Oberg system — doesn't use a spin-on filter. It consists of a two-piece aluminum housing that contains what's advertised as a 25-micron-wide screen. The Oberg screen is reusable — simply wash it out in mineral spirits and reinstall. This system also features a chip detector that turns on an instrument panel light when the screen is

approaching its holding capacity. ADC also manufactures and sells a wide range of STCed firewall-mounted spin-on filter adapters.

Filters — and installation tips

There are more spin-on oil filters on the market at the start of 2005 than ever before.

Champion Aerospace, Kelly Aerospace, and Tempest Plus Marketing Group have all issued press releases in the past year touting their new filters. Both Champion and Kelly say their new filters are better because of improved base plate threads, thicker can walls, and improvements in relief-valve design. Both of these filters are slightly shorter than the original Champion short filter, which will improve access in some installations. Tempest Plus, which was formed by two former longtime Champion Aerospace employees, has taken over the manufacturing and distribution of the original Champion filter. The company says its filters have the most filtering media, and that the filter bypass relief valve in its filter is the only one to comply with TCM specifications.

There's a bit of technique required to install and remove spin-on oil filters. Two things — lube and torque — make the difference between success and a struggle. When installing any spin-on filter, apply a thin film of Dow Corning DC-4 to the gasket. A tube of DC-4 can be bought from any of the large supply houses. When tightening the filter apply 16 to 18 foot pounds of torque. That's all it takes. Two companies — Approach Aviation, of Stow, Massachusetts, and F&M — sell torque wrenches set up for filter installations. If these steps are followed, filter removal will be painless. If not, filter removal could take hours.

The debate over which filter is best will probably go on until the last piston airplane flies off into the sunset, but this fact cannot be debated: Oil filters protect airplane engines much better than screens. There's a filter adapter for every engine in the general aviation fleet. Protect your engine — install one today.

E-mail the author at steve.ells@aopa.org.

Links to additional information about oil filters may be found on AOPA Online (www.aopa.org/pilot/links.shtml).