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Tempest Tech-Tip

Oil Filter Magnets

Background

It's well known that Tempest aviation oil filters are the only filters that contain a magnet. Why is that so; and why is it a good thing?

While it's easy to see big flakes of aluminum or brass in a filter element during filter inspection, it's virtually impossible to see fine steel particles such as those that might come from lifter/cam wear or valve to guide wear. But, if these fines are missed, an incipient engine problem might too be missed. The magnet in the filter consolidates the fines so the mechanic can see them, and it keeps the fines out of circulation in the oil so that they do no harm.

Oil Filter Media Porosity

The average porosity of aviation oil filter media is about 40 microns. There are smaller and larger pores in the media but, on average, the media will catch most of the 40 micron or larger particles. The smaller the particles in the oil, the fewer will be caught by a given media. For example, a 40 micron media may only stop 80% of 30 micron particles, 40% of 20 micron particles, and 10% of 5 micron particles. Steel particles in the oil are often five microns or less, so most will pass through the filter media and circulate, hour after hour, through the engine with the oil. Those particles cause wear when trapped between moving parts.

Over fifty hours of normal engine operation only a few particles will be visible around the edge of the filter's magnet. However, in a rapidly wearing engine the particles may completely cover the magnet. An experienced mechanic will investigate and find out what's wearing. In the decade since the introductions of magnets in Tempest filters, many engines have been saved from major damage or catastrophic failure by early detection of abnormal wear.

Oil System Flow

Ten to fifteen gallons of oil may flow through your airplane engine's lubricating system each minute. Therefore, the eight to twelve quarts of oil in your engine circulate through it at least a few times every minute. On each trip through the engine the fine steel particles wear away at engine parts, making even more fines. However, once those particles are trapped by the magnet they've been "taken out of circulation" and resultant wear.

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Some argue that such fine particles won't do any damage. Well, if someone were to suggest that you dump a spoon full of fine steel particles into your engine's oil system, you'd scream "NO"! Any steel particles in the oil cause wear that wouldn't happen if they weren't there! That's just common sense.

Oil Filter Micron Rating

So why not use finer filter media to screen the fines out? It's been tried; and rejected because it causes more problems than it solves. Airplane engines have high volume oil pumps and use thick oil. While a 15 or 20 micron or finer filter might work for a car, it will quickly plug up on an aircraft engine. That will force the oil system into filter by-pass mode. Then you'll have dirty oil circulating continuously. It's a subject for another article, but fine media isn't the answer.

By-Pass Valve Effect

Differential pressure (delta pressure) across the media inside the filter occurs when oil can't get through the filter media fast enough to prevent excessive back pressure in the filter. This can happen because of an excessively dirty filter element or because of super-cold, thick oil at start up. When the delta pressure in a Continental engine filter exceeds about 12 to 14 psi, a spring loaded valve (the by-pass valve) located in the filter cracks open. It bleeds some of the oil around the filter element and straight back to the engine. That prevents crushing the filter element or bursting the filter case. As the oil warms, the valve re-closes. (Obviously, if the valve is open because of an excessively dirty oil filter it will not re-close.) In Lycoming type engines this valve is usually in the engine accessory case, not in the filter. In remote or aftermarket filter adapters it may be in the adapter.

Anti-magnet naysayers suggest that when a filter mounted by-pass valve opens, fine particles might be swept off the magnet in the filter and go back into circulation in the oil.

Let's think about that for a minute and, for argument's sake, assume it's true. Say that after 40 hours of operation an amount of fines the size of a BB (.06 cc) has accumulated on the magnet. Then, one extremely cold morning, the engine is started and the rpm gets a little high, forcing the filter's by-pass valve open. Remember, were it not for the magnet 100% of the fine particles in the oil at any given moment would be circulating through the engine. Now, say that 2 percent of the particles on the magnet are temporarily (hypothetically) swept free and re-enter the oil stream. That's still only one fiftieth (1/50th) of the particles that, were it not for the magnet, would have been circulating through the engine continuously! Within a few minutes, as the oil warms up and the by-pass valve closes, the few particles that got back in circulation should be trapped by the magnet again.

What would you think is better for your engine? To have 100% of the particles going round and round through your engine, turbocharger, controllers, prop governor and so on, hour after hour; or for one-fiftieth of the particles to go through your

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engine for a minute or two until the by-pass valve re-closes and the magnet traps them again? Note that this anti-magnet / by-pass valve argument hinges on extremely cold weather engine starts forcing the by-pass valve open. But, in reality, during millions and millions of engine starts at average temperatures the conditions necessary for this argument to even flap its wings, much less fly, simply don't exist. And, in the cases of Lycoming type engines and some remote installations where the by-pass valves aren't in the filter, the anti-magnet argument can't be made at all!

Conclusion

It simply makes sense to keep all the damaging particles out of your engine's oil that you possibly can. That's the filter's job and why you bought it for your engine. The magnet just helps the filter do its job better, and it gives your mechanic one more tool to help him spot an incipient engine problem early. Both are good things.

Use Tempest oil filters with confidence. Use them with the knowledge that you are giving your engine the best protection available against damaging fine steel particles and your mechanic the best possible chance to keep your engine running safely all the way to TBO.

Additional Information

For additional information on this tech tip and other Tempest products, please go to www.tempestplus.com or call (800) 822-3200.

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