



**MIKE BUSCH**

HANDS ON / SAVVY AVIATOR



*Running a mechanic's magnetic pickup tool around in the drained oil is a good idea for any engine, but particularly for Continental engines where the suction screen cannot be inspected.*

# Making Metal?

How to ensure nothing is coming apart inside your crankcase

BY MIKE BUSCH

**I'D BEEN WORKING WITH** a Bonanza owner in Memphis for several weeks helping him chase down a problem with his Lycoming engine. Yes, Lycoming—the aircraft was an A36 with a Machen conversion to a fire-breathing 350-hp Lycoming TIO-540-J2BD engine. The owner of this hot-rod Bonanza initially reported that the engine had exhibited several episodes of rough running after start-up, but that the engine seemed to run smoothly once it warmed up.

**The No. 1 cylinder oil spray nozzle and its Heli-Coil had come out, bounced around inside the engine, managed to hit all six pistons, and scored two connecting rod end caps.**

The owner e-mailed me a data dump from his JPI engine monitor, which confirmed my suspicions that his “morning sickness” was caused by a couple of sticky exhaust valves in cylinders No. 4 and No. 5. Sticking exhaust valves is a fairly common malady in Lycomings, which is why Lycoming Service Bulletin 388C and Service Instruction 1481A call for doing a “valve wobble test” every 400 or 1,000 hours (depending on what kind of exhaust valve guides are installed).

The owner wound up taking his sick engine to an excellent engine shop near Memphis. The shop pulled the rocker covers and found the No. 4 exhaust valve springs black with carbon from a badly leaking exhaust valve guide. No. 5 had the same problem, but not quite as bad.

But this article isn't about sticky valves. It's about something much more serious.

## FLYING NOZZLE

The engine shop decided to inspect the cam and make sure it was not damaged by the valve-sticking episodes. In most Lycomings (unlike most Continentals), you can't remove the lifters from the outside of the engine, so the only way to inspect the cam is to pull a jug. The shop proceeded to pull cylinder No. 4, and it turned out to be a lucky thing it did. The owner e-mailed me:

“They pulled the No. 4 cylinder and found evidence of damage from a screw hammering the bottom of the piston. They also found marks on the crankcase on one side of the cylinder base. The engine was removed and torn down. They found that

the No. 1 cylinder oil spray nozzle and its Heli-Coil had come out, bounced around inside the engine for some indeterminate period of time, managed to hit all six pistons, and scored two connecting rod end caps.

“What is strange is there was no indication of this in the oil analysis or any evidence when we cut open the oil filter at each oil change. However, when I took your maintenance seminar in Tulsa a few months ago, I learned that Lycoming engines have a suction screen that you said is supposed to be removed and inspected for metal at every oil change. It was this screen that caught the metal from the disintegrating oil spray nozzle and its Heli-Coil, which is why the metal never made it to the filter.

“I checked with the shop that does my oil changes, and they admitted that they didn’t know about the oil screen—they’re mostly Continental dudes. I know I didn’t know about this screen (until I took your recent class), so I didn’t remove it either. After this, I will never forget it, and I’ll make sure my A&Ps don’t forget it.

“The inside of the engine, although marked by the flying nozzle, was extremely clean. The crankcase has to be repaired and certified as well as the camshaft. Little evidence of rust was detected on the lifters. All pistons and cylinders will be replaced. The turbocharger will also be overhauled. It looks like I’ll be down for a couple of months. When I get the plane back, I’ll need flying lessons again.



*This shrapnel was too big to pass through the suction screen, so was never spotted during oil filter inspections.*



*If you rely solely on oil filter inspection and oil analysis, you'll never know about stuff like this. Here's what was left of the Lycoming's flying oil nozzle.*

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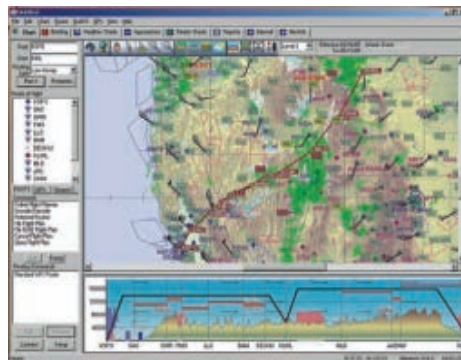
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"I wonder how much longer it would have taken for this to cause a catastrophic engine failure? I believe monitoring the engine helped find this, but clearly it would have been found much, much earlier had we been inspecting the pickup screen on a regular basis."

#### MONITORING FOR METAL

The oil system of any piston aircraft engine provides two levels of filtration. There's a relatively coarse suction screen at the oil pickup tube whose job is to catch large chunks of metal before they can get to the oil pump (and possibly damage it). Then there's a fine screen or oil filter after the oil pump whose job is to catch tiny pieces of metal before they can get to the engine's bearings (and possibly contaminate them).

*The Lycoming piston damaged by the flying oil nozzle. All six pistons, two connecting rod caps, and the inside of the crankcase were damaged.*

# THE VIKINGS

Are Here!



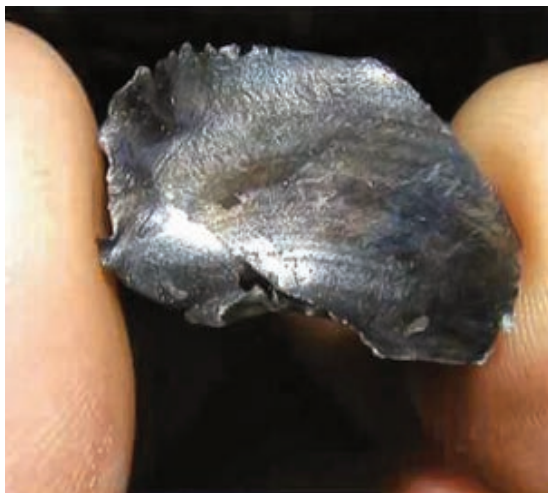
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If there's something like this floating around inside your engine, you really want to know about it!

When implementing a condition-monitoring program, it's crucial to understand that there are three distinct sizes of metal particles that we're looking for:

- **Large particles or flakes** that cannot pass through the suction screen.
- **Tiny particles** that are too small to be caught by the suction screen and get trapped in the oil filter.
- **Microscopic particles** that are too small to be trapped by the oil filter.

**To detect large particles or flakes, we cannot rely on filter inspection or oil analysis, because large stuff never makes it to the filter or into the sample jar.**


Therefore, our condition-monitoring program must comprise three distinct elements.

Since microscopic particles are too small to be trapped by the oil filter (and too small to see even if some were trapped), we must place the engine on a spectrographic oil analysis program (SOAP) to detect abnormal wear events that throw off such microscopic metal particles. An oil sample should be captured at every oil change and sent to the lab for analysis. (I use and highly recommend Blackstone Laboratories in Fort Wayne, Indiana.)


To detect tiny particles, we must remove and cut open the oil filter at every oil change. Tiny particles

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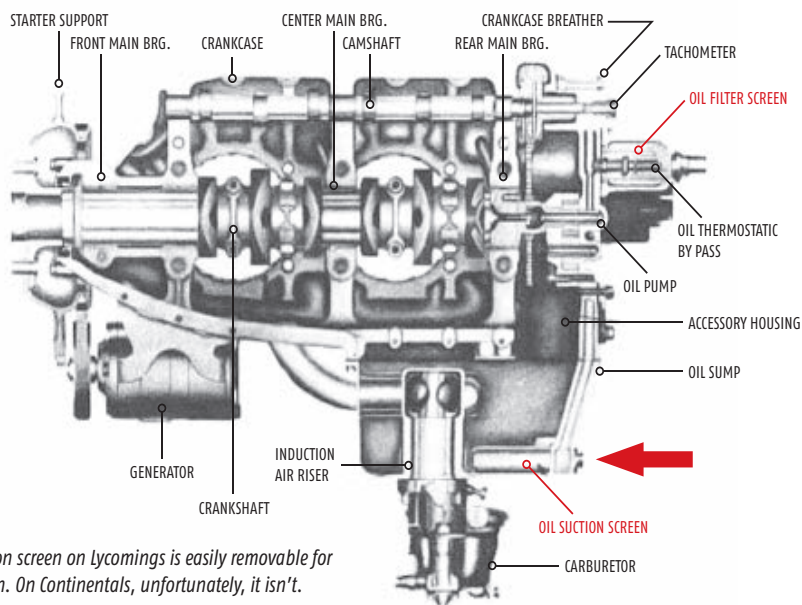
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## MIKE BUSCH



*The suction screen on Lycomings is easily removable for inspection. On Continentals, unfortunately, it isn't.*

## The worst engine problems—the ones that throw off large chunks or flakes of metal—often go undetected until it's too late.

can be hard to see, so it's essential to cut the filter media off its spool, spread it out flat, and carefully inspect each pleat under a bright light (and preferably with a magnifying glass). For engines that have only a fine oil filter instead of a spin-on full-flow oil filter, I strongly recommend adding a full-flow filter because it does a far better job of protecting the engine and provides a far better means for detecting problems before they cause a lot of damage.

To detect large particles or flakes, we cannot rely on filter inspection or oil analysis, because large stuff never makes it to the filter or into the sample jar. For Lycoming engines, we must remove and inspect the suction screen at every oil change. As we've seen, this step is often neglected and shockingly some A&Ps don't even know about it!

Unfortunately, most Continental engines do not permit the suction screen to be removed and inspected. (To gain access to the suction screen, you must drop the oil pan, something that usually can't be done while the engine is mounted in the aircraft.) So for Continentals, about the best we can do is to drain the oil through an external screen and then inspect it for any large particles or flakes of metal, and then

run a magnetic pickup tool around in the oil drain bucket to see if it picks up any pieces of ferrous metal. (This isn't a bad idea for Lycomings, too.) Alas, few A&P mechanics or aircraft owners perform these steps, either.

The result is that the worst engine problems—the ones that throw off large chunks or flakes of metal—often go undetected until it's too late. There's no excuse for this if we're doing our condition-monitoring job correctly.

If you do your own oil changes, make absolutely sure that you're inspecting the suction screen if your engine is a Lycoming, and that you're checking the drained oil for metal (using a screen and a magnet) if your engine is a Continental. If you have your oil changes done by a shop or mechanic, do not assume this is being done—check it out! **EAA**

**Mike Busch**, EAA 740170, was the 2008 National Aviation Maintenance Technician of the Year and has been a pilot for 44 years, logging more than 7,000 hours. He's a CFI and an A&P-IA. E-mail him at [mike.busch@savvyaviator.com](mailto:mike.busch@savvyaviator.com). Mike also hosts free maintenance webinars on the first Wednesday of each month at 8 p.m. (Central). To sign up or access the archives, visit [www.SavvyMX.com/webinar](http://www.SavvyMX.com/webinar).

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