The Oil Report

May 2004

"Oil the News That's Fit to Print!"

Oil Change Stickers: Fab or Folly?

A few months ago, we started sending out "oil change stickers" in kits to our customers. These are similar to the sticker you'd get at an oil change place for your car — it's meant for your windshield to reflect the last time the oil was changed, or the next time it needs to be changed.

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But we're not sure how well they have gone over! We have not heard anything either way — nothing good or bad. Some people have just left them in the container (perhaps not realizing they were there). So we are curious: Do you like them? Are they helpful? If they're not helpful, we'll stop sending them out. You can reply to the email that alerted you to this newsletter to let us know if you think we should keep them or not. Thanks for your input!

Spotlight on... Filter Analysis

by Mike Busch

We sometimes receive inquiries from people who have found metals on the drain plug or in the filter. Although we don't analyze those metals here at Blackstone, we can have them analyzed for you. Filter analysis is commonly performed on aircraft engines, and it can be very helpful in automotive gas and diesel engines as well. If you've never considered looking inside your oil filter, perhaps it's time to!

Filter analysis can be used by anyone operating an engine. The benefit to performing both wet (oil) and dry (filter) analysis is that you can cover the full range of potential problems. Wet oil analysis can analyze particles up to about 15 micron in size — too small to see with the naked eye — and can identify problems before they become too severe. Larger particles (those approaching visible size) tend to show damage from deteriorating parts and often show up in the filter. To get a complete picture of your engine's metal-making tendencies, you may want to run both wet and dry analysis.

Inspecting the Filter

To perform a filter analysis, you will need a good oil filter can cutter with a sharp cutting wheel. Cheap cutters tend to leave shards of the can in the filter medium, which can really confuse the filter inspection. Champion makes a good cutter, albeit pricey. Sacramento Sky Ranch offers a good oil filter can cutter ($75) and holder ($30) (www.sacskyranch.com or 800-433-3564). You may also be able to find them in a specialty automotive tool magazine, or you may even be able to get by with a large pipe cutter, depending on what size oil filter you have.

After cutting open the filter and cutting the filter medium from its spool with a sharp knife or hacksaw, take it outdoors and examine it in direct sunlight. If that's not practical, inspect the medium under the brightest light you can find. Small metallic particles embedded in the filter medium are reflective and will generally glisten when viewed in direct sunlight, but they may be invisible under ordinary indoor lighting.

Sometimes it's difficult to determine whether flakes in a filter are metal or carbon. Here's an easy way to tell them apart: Place some between your fingertips and rub your fingers while squeezing hard. Carbon flakes will break apart, while metal flakes won't.

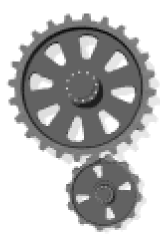
A newly overhauled engine or one that has recently been repaired will often have a small amount of fine metal particles in the oil filter, but once the break-in has been completed and the break-in oil replaced, any appreciable amount of metal in the filter should disappear.

How much metal is considered “appreciable”? There’s no hard-and-fast rule. One guideline is that anything more than about a quarter-thimbleful of small metal particles, or any single metal chunk larger than a pencil point, should be looked into further. Or, a better guideline may be that any substantial increase in metal above what has been the norm for your particular engine deserves a closer look.

The first step in that “closer look” is to rinse the filter medium in a clean jar or can using clean solvent to wash the particulate matter out of the filter medium. Then slowly pour the now-dirty solvent through a large, clean coffee filter. This will allow you to examine the particles much more clearly.

Next, pass a strong magnet underneath the filter paper to determine whether the metallic particles are ferrous (steel) or non-ferrous (aluminum, chrome, tin, bronze, etc.). A small amount of non-ferrous metal is normal; ferrous particles are of greater concern.

Non-ferrous metal can often be distinguished by appearance or other simple tests. Bronze particles have a characteristic yellow color. Chrome flakes are shiny, sharp, and very hard. Tin is dull and melts at a very low temperature. Aluminum will fizz and dissolve when exposed to lye.



What to Look for in the Filter

Carbon particles. A certain amount of carbon in the filter is normal, and turbocharged engines generally exhibit more carbon than do normally aspirated ones. An unusually large amount of carbon in the filter suggests that oil is getting excessively hot and coking. This can be caused by several things. One is excessive blow-by past the rings, and is usually accompanied by elevated oil consumption and marginal compression readings in one or more cylinders. Another cause is one or more badly worn exhaust valve guides, and is usually accompanied by carbon build-up under the cylinder rocker covers, heat-damaged valve springs, and/or valves that move more than a very small amount in a “wobble test.”

Steel. Steel is readily identifiable because it is magnetic. Any significant quantity of steel particles or flakes in the filter is cause for concern. If you can’t find the cause of the steel, you may want to consider sending your filter contents to an expert for microscopic examination, which often can pinpoint the source.

Aluminum. These are silver-colored non-magnetic particles that dissolve when exposed to a dilute solution of sodium hydroxide (lye), including common household drain cleaners like Drano and Red Devil. Small amounts of aluminum are normal in some engines, but significant quantities warrant further investigation. Possible sources of small aluminum particles include the head or the block itself, burned pistons (possibly caused by preignition), and some types of bearings.

Chrome. Chrome is shinier than aluminum and much harder, and it is often found as flakes rather than particles that feel sharp to the touch. Any amount of chrome in the filter is not normal except possibly during break-in. The most common source is from chrome-plated piston rings abraded by a rough or pitted cylinders.

Brass/copper/bronze. Identified by its distinctive yellow color. These particles mainly come from worn bushings and bearings.

Dry Particle Analysis

As with oil analysis, it’s nice to have something to compare your findings to, so you may want to check for metal in the filter after several different oil changes. This will give you an idea on what a normal amount of metal is for your engine.

If you find metal in the filter that makes you think something might be coming apart inside your engine, it's often a good idea to seal the filter contents in a plastic bag and send it to a lab for microscopic dry particle analysis.

An expert can often tell from the size, shape, and appearance of the particles or flakes, as seen under the microscope, whether they came from a spalled lifter, a damaged cam, an oil-starved main or rod journal, a defective gear, or a scored cylinder liner. An excellent resource for filter analysis is Howard Fenton's Second OilPinion service. Howard will perform microscopic analysis and render an opinion for a very reasonable fee. He presently charges just $15 is you send him your filter medium in a plastic bag, or $30 if you send him the whole filter and he has to cut it open. Howard is a world-class expert on filter oil analysis. You can contact him at 918-492-5844.

This article originally appeared in *Cessna Pilots Association Magazine* (http://www.cessna.org/) and is reprinted here by permission. Author Mike Busch may be contacted via his website at http://www.savvyaviator.com/. We have modified the article slightly to be appropriate for gas and diesel engines.

Report of the Month

What's wrong with this engine? See the caption below for an explanation. Don't look right away -- take a good look at the report first.

(To learn where the various elements might be coming from, click here.)

Elements in Parts Per Million

MI/HR ON OIL	27,899	UNIT/ LOCATION AVERAGES	7,734				UNIVERSAL AVERAGES
MI/HR ON UNIT	35,633		7,734				
SAMPLE DATE	3/11/04		12/17/03				
ALUMINUM	8	4	**4**				2
CHROMIUM	9	4	5				0
IRON	178	97	**100**				14
COPPER	186	49	15				5
LEAD	3	4	**6**				2
TIN	0	1	1				1
MOLYBDENUM	6	25	65				11
NICKEL	9	3	7				0
POTASSIUM	5	7	17				1
BORON	0	34	99				146
SILICON	7	8	14				5
SODIUM	3	3	5				3
CALCIUM	3108	3226	3387				2698
MAGNESIUM	5	8	7				90
PHOSPHORUS	989	990	1058				1014
ZINC	1019	1165	1290				1195
BARIUM	0	0	1				0

TEST	cST VISCOSITY @ 40 C	SUS VISCOSITY@ 100 C	cST VISCOSITY@ 100 C	SUS VISCOSITY @ 210 F	FLASHPOINT IN F	FUEL %	ANTI-FREEZE %	WATER %	INSOLUBLES %
VALUES SHOULD BE				68-77	>410	<2.0	0.0	<0.1	0.7

Properties	TESTED VALUES WERE				93.4	425	<0.5	0.0	0.0	0.5

This Mack E7 427 is still fairly new, but the owner has not given the engine sufficient chance to wear in before starting on extended oil changes. The metals and silicon are normal in the first sample -- metals are high from new parts breaking in, while silicon is from sealers and sand-casted parts. But the owner ran the second oil in the engine for more than 27,000 miles, and look how high the metals are (especially iron and copper). While we consider metals and silicon to be normal in new engines, they do cause the oil to be abrasive and should be removed from the system sooner, rather than later. And while we whole-heartedly support extended oil change intervals, we do recommend waiting until after the engine is past wear-in to start the process. The long oil change interval has also thickened the oil (note the viscosity) into the 50W range.

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