BLACKSTONE LABORATORIES

The Oil Report

October 2012

Oil the News that's Fit to Print!

It's only October, but the stores already have Christmas stuff out and before you know it, you'll be snapping your fingers to "Jingle Bell Rock" in the car. So we figured this is the perfect time for you plan-ahead people. Think of Blackstone gift certificates as your one-stop shopping for the holidays. Your in-laws can use an analysis for their motorhome! Your boss needs one for her new BMW! Kids love oil analysis! (Well, okay, maybe the kids would prefer an X-Box.) Contact us at 260/744-2380 to learn more about our new gift certificates!

The Aircraft Instrument Your Instructor Never Told You About

by John Schwaner

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I was shocked when I realized that a pilot could suffer a catastrophic engine failure with all the instruments "in the green." The airplane was a Piper Navajo, the pilot was a flight instructor, and the co-pilot was an experienced pilot and mechanic. The Bendix D-2000 magneto started cross-firing. Cross-fire results in pre-ignition, which burns large holes through pistons and blows combustion gas into the crankcase, forcing all of your engine oil out the engine breather.

The pilot and co-pilot weren't aware of the problem until they saw the oil pressure gauge fluctuate and shortly thereafter a connecting rod was released out the side of the engine. Both were unaware of any pre-ignition, both were unaware of the hole through the piston. Within the next six months we saw two other engine failures caused by D-2000 magnetos where the engines failed "in the green." Over the next 20 years while I ran an engine overhaul shop, I saw other "in the green" engine failures and it got me to thinking about how inadequate engine instruments were.

When we found engines with completely smashed camshaft lobes and asked pilots how the engine operated, almost always the answer was "great." The list of engine problems that instruments could not detect, and that most pilots couldn't detect, grew in length as I asked pilots about how engines operated. Bent push rods -- "the engine ran fine." Leaking exhaust valves "ran like a watch." The list of "in the green" engine problems includes:

1. Bent push rods
2. Leaking exhaust valves
3. Internal engine timing off
4. Pre-ignition
5. Detonation
6. Low power (here defined as more than 5% loss)
7. Camshaft lobes worn down

Occasionally, a pilot would be aware of an engine problem that fit into the above category. In almost every case the aircraft instrument that was used to monitor the engine was the pilot's sense of sound and feel. These other

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pilots have improved their ability to detect “in the green” engine problems. How can we develop our sense of sound and feel to monitor engine conditions that our mechanical instruments cannot detect?

During my dual cross-country, my flight instructor told me upon landing that we had a fouled spark plug. He did a magneto check on first one magneto and then the other and sure enough the engine ran rough. My flight instructor had sensed the engine roughness while I, the student pilot, didn’t feel a thing. I felt awed and impressed but none-the-wiser on how he performed this small miracle. Most likely your flight instructor never told you how to use your sense of sound and feel as an engine instrument. I don’t have the all answers but do have some ideas on how we might start.

Learning by trial and error
If you fly a carbureted, non-turbocharged engine, can you find best power mixture by feel rather than the EGT gauge? If so, great. If not, pick a smooth day without any radio distractions, set yourself up in cruise and ever so slowly pull the mixture control out until you feel the power increase and then the power decrease. You should be able to nail the best power mixture. With power below 65%, you can find peak EGT by leaning very slowly until you just start to feel an occasional bit of engine roughness. Richen slightly and you are probably very close to peak EGT, or maybe just past on 1 or 2 cylinders. The idea here is not to teach you a new leaning technique but to show how you can feel the engine in a way that maybe you haven’t before.

Bent push rods, internal engine timing off, and worn-down camshaft lobes result in a smooth-running engine that is low in power. In the case of a bad camshaft, the reduction in engine power occurs over a long period of time so there is no noticeable difference in engine operation from one day to the other. However, pilots who have noticed something wrong usually report low power as “It takes longer to take off” or “It’s a dog” when referring to a particular rental airplane, higher fuel consumption, poor climb performance, or low static rpm. Just how much power loss can a pilot typically notice?

An engine that is missing 5% horsepower will not be noticeable to a fixed wing pilot. In a helicopter yes, but not in an airplane. For example, worn spark plugs will cause an engine to lose 5%. Horsepower gives you climb performance. Aerodynamics gives you speed performance, so your first indication that your engine power may be low is long take-off runs, poor climb performance. As you know humidity, load, and density altitude affect take off and climb performance, so detecting low power by methods other than static rpm requires a lot of flying experience with a particular aircraft. You should develop a feel for how fast and how high you climb at take off under standard conditions.

If your airplane has a fixed-pitch propeller and a published static rpm range, you can check engine power by doing a static rpm run-up and comparing it with the published values. If these values aren’t published you can make comparisons based on past experience.

Pre-ignition and detonation and other engine problems that cause engine roughness depend upon your sense of feel. You have no other instrument to detect engine roughness but your sense of feel through your butt. When you leaned the engine to slight engine roughness above you used your sense of feel to find engine roughness. Stuck valves, hydraulic lifters not working properly, magneto problems, and engine bearing failures cause some engine roughness. Slight engine roughness caused by a magneto can usually be turned on and off by selecting the L or R magneto or by noticing if the roughness comes with altitude and goes away as you descend.

I quickly found when analyzing engine failures that you need to know what normal looks like. What does a normal valve look like after 2,000 hours? What should a bearing look like after 800 hours? Only when you are familiar with the normal can you detect the abnormal. The same with detecting engine roughness. Spend some time feeling the engine during normal operation so when the engine changes you know it instantly. That is how my first flight instructor knew the spark plug was fouled. He had spent so much time in trainers that he knew what normal felt like. As a student, I hadn’t developed the feel. If you don’t pay attention to the sound and feel of your engine you may never develop that feel -- but if you relax during a quiet smooth flight and sense the aircraft, you might tune your body into becoming a better aircraft instrument.

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Report of the Month

This O-540 looked terrible after its overhaul. Why?

To learn more about where the elements are coming from, click here.

ELEMENTS IN PARTS PER MILLION

		UNIT/ LOCATION AVERAGES					UNIVERSAL AVERAGES
MI/HR on Oil	39		61	35	7	6	
MI/HR on Unit	224		185	124	90	83	
Sample Date	06/06/12		11/11/11	05/17/11	03/29/11	08/25/10	
ALUMINUM	2	11	22	9	8	8	6
CHROME	1	44	21	10	10	9	8
IRON	21	81	141	39	45	89	27
COPPER	3	22	69	28	14	11	7
LEAD	3185	1902	4787	1864	918	762	2833
TIN	0	2	0	0	0	0	1
MO LYBDENUM	2	0	1	0	0	0	0
NICKEL	1	2	4	1	1	1	2
PO TASSIUM	0	1	0	1	1	1	1
BORON	0	1	2	1	0	1	0
SILICON	3	6	7	5	4	4	6
SODIUM	0	0	0	0	0	0	1
CALCIUM	7	2	7	1	1	1	11
MAGNESIUM	2	3	7	2	1	6	8
PHOSPHORUS	0	1	0	0	0	0	695
ZINC	1	2	14	2	1	1	6
BARIUM	0	0	0	0	0	0	0

PROPERTIES

		Values Should Be*				
SUS Viscosity @210°F	92.4	86-105	87.4	86.0	72.3	69.7
cSt Viscosity @ 100°C	18.55	17.0-21.8	17.35	17.01	13.56	12.88
Flashpoint in °F	475	>460	535	470	485	495
Fuel %	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5
Antifreeze %	-	-	-	-	-	-
Water %	0.0	0.0	0.0	0.0	0.0	TR
Insolubles %	0.4	<0.6	0.5	0.4	0.3	0.3
TBN						
TAN						
ISO Code						

*THIS COLUMN APPLIES ONLY TO THE CURRENT SAMPLE

The original problem was an issue with the prop governor that spread metal throughout the engine, prompting the overhaul. Unfortunately, the oil sump had a cavity that was not obvious to see, and lots of metal had accumulated there. When the overhauler cleaned the metal out of the case, he missed the small cavity. The initial samples after the overhaul looked terrible. Then things seemed to improve, but the improvement wasn't real--metals just read lower because the oil was only run 6 and 7 hours. When they did longer runs in May and November, that's when the cavity full of metal really showed itself. They took the sump off and looked inside, and sure enough it was full of metal. After a thorough cleaning, the sump was put back in service and the next report was much better.

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