The Great Oil

EMISSIONS VS.

I don't want to open a floodgate of opinions about engine oils and what works best for which engines, but I do want to caution readers that recent changes in engine oil formulas potentially have a significant affect on vintage engines.

My concern began early last year with a rash of vintage GMC inline engine camshaft failures on recent rebuilds. As one engine rebuilder put it, "I've failed more cams in the last three years than I have in the last 30." Clearly something had changed.

Credit for enlightening me on this subject must be given to Tony Pascarella of Ontario, New York. Tony is a vintage truck builder, a member of our oldGMCtrucks.com group, and a GMC inline engine performance guru. He was the first to identify the problem. After wiping out a cam in less than 500 miles on his hopped-up 302 GMC inline 6-cylinder engine, which he is running in his '37 Chevy pickup, Tony figured out that the oil was the problem.

Like many vintage truck owners and enthusiasts, I do all my own oil changes and service, so I pay attention when people have problems that ultimately point toward oil as the likely culprit. I researched the topic on the internet and immediately began to notice a pattern—these cam failures were almost exclusively happening in flat-tappet engines. Roller bearing cam engines were seemingly unaffected.

Thanks to Tony pointing the way, I focused on recent changes in engine oil formulas implemented to meet ever-increasing emissions standards. As I understand it, the amount of zinc dialkyl dithiophosphate (ZDDP) in the oil formula was reduced at the request of vehicle manufacturers. Apparently, ZDDP contributed to the premature failure of oxygen sensors and catalytic converters by loading them with zinc phosphate plaque.

Now this is the part of the story where worlds collide. In the 1980s, heavy metal inhibitors in engine oils were reduced to comply with increasingly restrictive emission standards. The most recent change in these formulas all but eliminated ZDDP in gasoline engine oils. I wrote to three popular manufacturers of engine oils about this topic and two responded.

Castrol's customer service department wrote: "As indicated on our product packaging, the current engine oil category API SL/ILSAC GF-4 is fully backwards compatible or 'back serviceable' and has been extensively tested. Valve train issues are not anticipated with the use of modern engine oil in older cars of OEM stock configuration. In fact, current SL/GF-4 engine oils are subjected to testing that is far more intensive than engine oils of previous API/ILSAC categories.

"To clarify, in general, ZDDP levels have been reduced a small amount in the current category engine oils (API SL/ILSAC GF-4) in compliance with industry regulations that set maximum levels of sulphur and phosphorus, but are still at levels that provide ample engine protection."

Castrol went on to caution that properly formulated engine break-in additives containing high levels of molybdenum are recommended.

Mark Ferner, team leader for Quaker State Motor Oil Research and Development, said, "Even stock passenger cars can see pressure in excess of 200,000 psi at the point of flat-tappet/cam lobe contact. The zinc reacts with the cam lobe's iron surface. That creates a sacrificial chemical coating strong enough to keep parts separated to reduce the wear."

So now we're getting somewhere. Representatives for both companies readily acknowledge that levels have been reduced and that the zinc is an important component to flat-tappet engines.

Debate ADDITIVES

YOU NEED TO BE VERY CAREFUL ABOUT THE TYPE OF OIL YOU USE, AND YOU NEED TO STAY AWARE OF CHANGES IN ENGINE OIL FORMULAS THAT MIGHT PUT YOUR VINTAGE ENGINE AT RISK.

Therein lies what I believe to be the very heart of this problem: given the earlier reductions of these additives in the '80s, a "slight" reduction in 2006 was the straw that broke the camel's back. Something definitely is killing these camshafts, and it's not excessive spring pressures alone.

The solution, as I see it, is switching from gasoline engine oils to diesel engine oils, which have much higher levels of ZDDP and other lubrication goodies. Many engine builders even recommend the use of diesel engine oils along with break-in additives to provide adequate lubrication on flat-tappet engines both during and after break-in.

"The Automotive Engine Rebuilders Association (AERA) recently issued a technical bulletin on this very subject," said John Gulbankian, owner of the popular vintage-engine rebuilding shop J & M Machine of Southborough, Massachusetts. "The bulletin cautioned its member rebuilders to use diesel engine oils plus break-in additives for the initial break-in on any flat-tappet engines." The AERA provided a detailed breakdown of zinc and other additives in several products and recommend Chevron's Delo®, Mobil's Delvac®, and Shell's Rotella-T®, which all contain high levels of these important lubricants.

Gasoline engine oils meeting the American Petroleum Institute's (API) service category of API SM and GF-4 specifications have reduced ZDDP content so much that I believe flat-tappet-equipped engines—whether a new rebuild or in-service older engine—are now at risk. Using diesel engine oils meeting the API CI-4/SL (CI-4 Plus) service category may be a short-lived solution. Future API service category standards may, and likely will, further reduce these metal phosphate additives in diesel engine oils as the new 2007 diesel engine standards become more popular.

I don't know what the future will bring, but one thing is clear—you need to be very careful about the type of oil you use, and you need to stay aware of changes in engine oil formulas that might put your vintage engine at risk. With the new 2007 diesel standards, the addition of a catalytic converter, ultra-low sulfur fuels, and ten ppm filters on exhaust systems, there is a strong potential for further reductions in ZDDP.

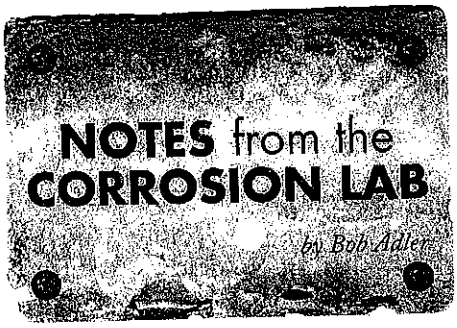
Until early 2006, I was a dyed-in-the-wool Castrol GTX man. I have used Castrol oils exclusively, and they have never failed me. The company's record continues to hold true, but I have changed the type of Castrol oil that I use in my vintage gasoline engines. Last year, I switched to Tection Extra, which is a diesel engine multi-viscosity (15W40) oil meeting the CI-4 Plus API service category. Currently, I am considering adding GM's Camshaft and Lifter Prelube (part number 12345501) at every oil change to protect my flat-tappet engines if the diesel engine oils further reduce their additives.

On the back of every oil container you will find the API "medallion," indicating which service category the oil in that container conforms with. For the time being, I am sticking tight with the CI-4 Plus diesel engine oil service category but paying attention to developments to avoid any surprises in the future.

As a final interesting note, Gulbankian mentioned that one of the worse things a vintage engine owner can do is hop around among oil brands. He cited a study of New York City taxis that measured the effect of using one or more brands of oil in gas engines. The study, which was published in *Consumer Reports*, proved engines using just one brand ran longer than those using multiple brands. Whatever you decide is right for your vintage engine, be sure to stick with it and don't change brands—unless, of course, you would like to get to know Gulbankian and his company a little better.

SOURCES

- **J & M Machine Co.**, 40 Mount Vickery Road, Southborough, MA 01772; phone, 508-460-0733; website, www.jandm-machine.com
- **Aldrich Automotive Machine**, Hatfield, Massachusetts
- **Automotive Engine Rebuilders Association**, Buffalo Grove, Illinois; website, www.aera.org
- **Primedia, Inc.**, Los Angeles, California; website, www.hotrod.com
- **Chevron Global Lubricants**, San Ramon, California; website, https://businesspoint.chevron.com/
- **Shell Lubricants**, Houston, Texas; phone, 800-64LUBES; website, www.rotella.com
- **Quaker State**, Houston, Texas; phone, 800-458-4998; website, www.quakerstate.com
- **Exxon Mobil Corp.**, Fairfax, Virginia; website, www.mobil.com



Oil Analysis

"Hey, Doc, how's my heart?" is a question many of us ask sooner or later. The response goes something like this: "We'll do an EKG and draw enough blood for a lipid profile. Then we'll soon see if your coronary arteries are sludged up." A medical checkup can show where some maintenance is needed, and it's worth doing similar testing with engine oil to evaluate the health of your vehicle's engine.

Bruce bought a Cantrell-bodied 1947 Dodge WC, which arrived at my shop on a car carrier last month. My instructions were to drive it, check it over, and make up a list of deficiencies. The Dodge's odometer read 48,332 miles, which seemed to be the original mileage. Its flathead-six engine had snappy performance and good compression.

My shop in Stephentown, New York, is in the foothills of the Berkshire Mountains, and I have a favorite hill right outside my door for testing performance. The Dodge sailed up the hill smartly. Coasting back down, however, was another story. Blue smoke issued from the tailpipe, and the amount was beyond the acceptable limit. My first thought was leaky rings, valve guides, and valve seals.

Testing the Oil

I wanted more information before recommending a complete engine overhaul, so I decided to send an engine oil sample to Blackstone Laboratories for analysis. While I was at it, I drained some transmission and rear axle lubricant into sample bottles and mailed all three to the lab. I believe most automobilists check and add transmission and rear end lube occasionally, but do not actually drain and change these fluids on any specific schedule.

Blackstone does four tests on an oil sample to gauge the health of an engine. They indicate what oil contaminants are present and where they most likely came from.

Years ago, an old timer taught me to pull the dipstick on an engine, sniff for burnt odors and the smell of gasoline, then rub some oil between my fingers to check for grit. The oil analysis is more scientific and accurate.

According to Jim at Blackstone, you will always smell gasoline in the oil unless the engine has just been run on a long trip, which would evaporate all fuel dilution. Your nose is very sensitive, and smelling gas in the oil does not indicate any harm to the engine. As for the grit, Jim said if you're at the point where you can feel it, your engine is already in trouble.

The Blackstone reports compare your results against universal averages and interpret them. In my case the reports flagged antifreeze contamination, high wear, and fuel dilution. Comments for my sample concluded with, "Suggest having a close look at this engine."

I asked Jim how he knew antifreeze was doing damage. He explained the potassium and sodium levels were two orders of magnitude above the norm, and these come from antifreeze additives. These circulating in motor oil destroy its lubricity. Then he looked at iron—also two orders of magnitude high—which are the cylinder walls, shafts, and valves wearing away.

I removed the engine and took it to a machine shop to have it Magnafluxed and pressure tested for cracks as the initial phase of a complete overhaul. I thought the head gasket could be leaking antifreeze or the engine had a cracked head or block casting.

The drained transmission lubricant was deep black and had a strong pungent odor associated with gear lube we used decades ago. I thought it was a molybdenum disulphide additive, but the report listed zero for molybdenum content. "Moly" extreme pressure additive is a solid lubricant suspended in the oil, and it tends to settle out as sludge in a gearbox that is infrequently used.

Blackstone's comments on the transmission oil were: "Iron was high in this sample. No moisture was found, but insolubles (oil oxidation due to heat and use) were at limits. The iron is likely from the gears shifting and corrosion from inactivity, but the excess wear metals make the oil abrasive. All other wear looks good, so we doubt the high iron indicates a mechanical problem developing."

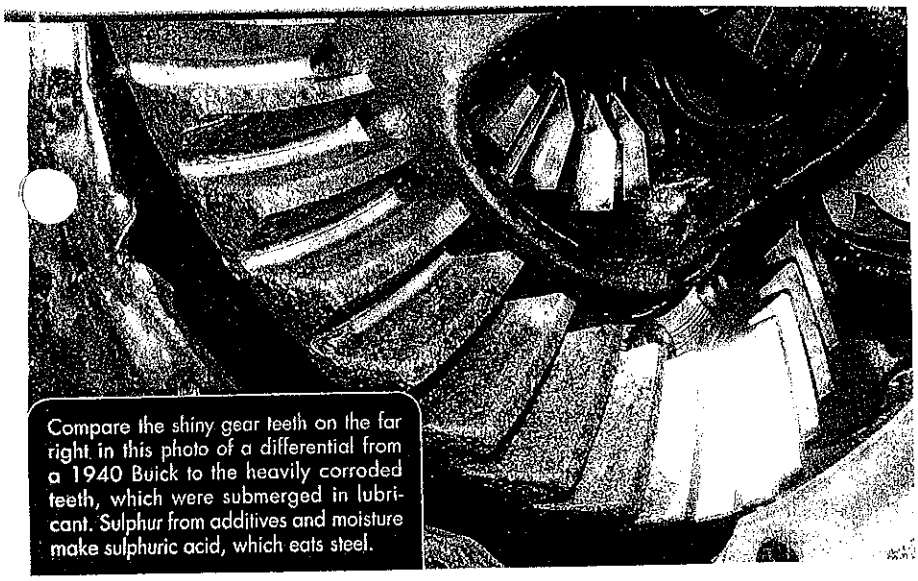
The transmission shifted very smoothly for a non-synchronized unit and, based on this report, I do not plan to open it up.

BLACKSTONE LABORATORIES

ELEMENTS IN PARTS PER MILLION	MICHIGAN OIL		UNIT / LOCATION AVERAGES	UNIVERSAL AVERAGES
	VEHICLE/UNIT	48,342		
	SAMPLE DATE	04/26/07		
	ALUMINUM	9	9	4
	CHROMIUM	1	1	2
	IRON	693	693	24
	COPPER	81	81	39
	LEAD	465	465	406
	TIN	17	17	3
	MOLYBDENUM	11	11	30
	NICKEL	1	1	0
	MANGANESE	7	7	14
	SILVER	0	0	0
	TITANIUM	0	0	0
	POTASSIUM	554	554	2
	BORON	91	91	36
	SILICON	13	13	22
	SODIUM	772	772	7
	CALCIUM	136	136	956
	MAGNESIUM	56	56	502
	PHOSPHORUS	696	696	856
	ZINC	413	413	1080
	BARIUM	80	80	2

PROPERTIES	TEST						
	VALUES SHOULD BE	56-62	>365	<1.0	0	<0.1	<0.7
	TESTED VALUES WERE	67.2	255	5.5	1.64	0.0	10.0

416 EAST PETTIT AVE
FORT WAYNE, IN 46806 (260) 744-2380



Compare the shiny gear teeth on the far right in this photo of a differential from a 1940 Buick to the heavily corroded teeth, which were submerged in lubricant. Sulphur from additives and moisture make sulphuric acid, which eats steel.

Regarding the differential report, Blackstone commented, "Bob, this looks like the original fill of oil in this differential. That would explain the high insolubles (2.0 percent, should be 0.8 percent max), which show the oil is heavily oxidized. The high iron (1,406 ppm vs. 318 ppm average) and nickel (13 ppm vs. 3 ppm average) likely point to excess wear at the ring and pinion gears. ıd (1,334 ppm vs. 7 ppm average) is likely from the marking compound from the factory. We found no moisture. The viscosity is high due to the insolubles. Wear is high in this sample, but we think changing this oil will make a big improvement. We suggest changing this oil to wash the excess wear metals from the system. Check back in 500 to 1,000 miles to monitor."

I've found rear end ring gears tend to corrode and pit on the segment that stays under the oil level for long periods of time. I asked Blackstone to explain why.

Ryan told me all oils have some sulphur in them, and when moisture is present, it makes sulphuric acid. It's not very strong, but throughout the years, it does considerable damage. Newer oil formulations use phosphorus, which has less potential for corrosion, in place of sulphur. Newer oil formulations also have corro- ın inhibitors to prevent this problem.

Set up a regular oil change schedule for your transmission and rear end. A five-year cycle is about right. I don't think a rear axle can heat up enough to boil off moisture during use. If the gears get hot enough in the differential housing to vaporize water, most will condense in the cooler axle tube and run right back into the sump. This "still" effect also happens in an engine, with some water condensing in the cooler valve cover and dropping back to the oil pan. It's important to have an operational road draft tube or PVC valve to help remove engine vapors.

We change oil when contaminants build up and additives are depleted. I asked Jim if the elemental analysis shows if the additives are depleted. "No," he said, "for that you need an additional test for the total base number."

Jim agreed that for a limited-use antique that was driven, perhaps, 1,000 miles per year, a single annual engine oil change is sufficient. If done in the fall before winter hibernation, it will minimize corrosive moisture.

The last tip Jim had was to drive the vehicle. Run the engine regularly—once a month is sufficient—and run it long enough to heat it up fully to boil off moisture. If you are in a cold climate, don't start it unless you can run it on the highway. A truck with a road draft tube needs to be moving at highway speed to properly ventilate its crankcase.

Bob Adler is owner of Adler's Antique Autos, Inc. in Stephentown, New York, which specializes in GM truck restoration. He can be reached at 518-733-5749 or bobadler@nycap.rr.com.

WHAT IS OIL ANALYSIS?

From Blackstone's website (www.blackstone-labs.com)

Oil analysis is a quick, nondestructive way to gauge the health of an engine by looking at what's in the oil.

What does a standard analysis include?

In our standard oil analysis, we perform four tests.

Spectral Exam

In the spectral exam, we take a portion of your oil sample and run it through a machine called a spectrometer. The spectrometer analyzes the oil and tells us the levels of the various metals and additives that are present in the oil. This gives us a gauge of how much your engine is wearing.

Insolubles Test

The insolubles test measures the amount of solids that are present in the oil. The solids are formed in several ways: oil oxidation (when the oil breaks down due to the presence of oxygen; accelerated by heat), the effectiveness of the oil filter, and blow-by past the rings. When the insolubles get too high, the oil becomes abrasive.

Viscosity Test

The viscosity measures the grade or thickness of the oil. Whether it's supposed to be a 5W/30, 15W/40, or some other grade, we will know (within a range) what the viscosity should be. If your viscosity falls outside that range, there's probably a reason—the oil could have been overheated or contaminated with fuel, moisture, or coolant.

Flash Point Test

This test measures the temperature at which the oil burns. For any specific grade of oil, we know what temperature the oil should flash at. If it flashes at or above that level, the oil is not contaminated. If the oil flashes off lower than it should, then it's probably been contaminated with something. Fuel is the most common contaminant in oil.

We can perform our standard oil analysis on any sample of oil, whether it's engine oil, transmission oil, an oil-based additive, power steering fluid, lube oil, or hydraulic oil.