

Engine Oil Revisited
January 10, 2008

When I finished writing the first edition of *The Shadow Owners Companion* in the Fall of 2006, the prevailing wisdom on motor oil was straightforward – make sure that your motor oil choice is rich in ZDDP (zinc dialkyl dithiophosphate). Quite a bit has been written about this subject in club magazines since then including the September 2007 issue of *Self Starter* from the Cadillac-LaSalle Club. This particular article has been mentioned quite a bit in classic car circles recently. Chock full of good information, a few of the recommended oils are no longer available, so here are some new recommendations and some additional thoughts on the subject as well.

Despite what you may think, the much-maligned EPA is not at the center of this maelstrom; rather, the North American automotive OEMs have put pressure on the American Petroleum Institute (API) to release new standards that lower the amount of phosphorus in motor oil. Phosphorus tends to reduce the efficacy of the catalyst over time and with new mandates requiring emissions systems warranties up to 120,000 miles, reducing the amount of phosphorus enables the OEMs to specify smaller (and less expensive) catalysts. These reduced-spec oils appeared on passenger car motor oils API rated SM and subsequently on diesel oils (like Shell Rotella T and Mobil Delvac Super 1300) API rated CJ-4. The CJ-4 spec with reduced ZDDP became necessary as all over-the-road diesels including tractor trailers came equipped with catalysts starting with the 2007 model year.

Why do we need an oil rich in ZDDP? This compound bonds with the ferrous elements in your engine and provides a protective anti-scuffing function that prevents damage at the points that experience the highest metal to metal pressures. For classic car engines with flat tappets, the major pressure point is where the cam slides against the tappet face. These pressures are worst with engines that have heavy valve springs – for example, those with aggressive cam profiles, large valves and/or high rev limits. Although our engines have big valves, our cam profiles are mild and rev limits low. This puts our engines at less immediate risk than say a vintage Porsche 356 or 396 Chevelle. These engines accumulate cam wear in their engines at a faster rate, and we can thank their owners for determining the root cause and finding a path to salvation.

This concern does not equally apply to all Rolls-Royce and Bentley motors. Roller tappet engines are at less risk than their flat tappet brethren because the sliding friction is not as great. If you own a pre-war Rolls-Royce or Bentley, you can relax as only the Phantom II, Phantom III, Wraith and (ultra rare) Mark V have flat tappets. Unfortunately, almost all post-war Rolls-Royce and Bentley engines have flat tappet designs with the exception the Silver Seraph and Green Label Bentley Arnage, Bentley Continental GT, and the New Phantom.

Given the relatively conservative design of our engines, having done an oil change or two with the new low ZDDP oils probably will not have a discernible effect on the life of your already broken in engine. It's somewhat like drinking or smoking – the cumulative effect is what leads to health problems.

Rebuilt engines are an entirely different kettle of fish. The sporting and muscle car folks have experienced the bulk of the problems with gross camshaft failures during the break-in period, with less than 1,500 miles on the clock. If you are in the process of rebuilding an engine, oil selection is critical until everything is broken in.

How much ZDDP is enough? Most of the automotive pundits seem to agree that a proper motor oil for a flat tappet engine should test with a minimum of 1,200 PPM (0.12%) by weight each for zinc and phosphorus.* The now discontinued CI-4 rated Shell Rotella T and Mobil Delvac Super 1300 had over 1,300 PPM of zinc and phosphorus. The discontinued SL rated versions of Mobil 1 all had over 1,400 PPM[†] for each. Unfortunately, virtually all of the currently available oils with the latest SM or CJ-4 designations have zinc and phosphorus levels at or below 1,000 PPM.

You can still buy “boutique” oils with the proper formulation. Depending on the manufacturer, these might not be API rated. Quite often, they are labeled for motorcycle or racing use and usually available at speed shops and through the internet. (Yes, it is legal to mail motor oil within the United States as the flash point is well above 200°F, which is what the regulations for flammable liquids require.) Based on lab tests tabulated by LN Engineering, a manufacturer of performance parts for classic Porsches in California, choices for properly formulated oils in relevant grades for Silver Shadow and Silver Spur era 6.23/6.75L V-8s are shown in Table 1.

* The 1977 SAE paper “Cam and Lifter Wear as Affected by Engine Oil ZDP Concentration and Type” written by two GM Engineers provides plenty of data to support the assertion that 1200 PPM is “knee” in the curve of wear rate vs. ZDDP concentration for flat tappet engines.

† With the exception of SL-rated Mobil 1 0W-40, which had ~1,000 PPM of zinc and phosphorus.

Brand	Viscosity	Zinc (ppm)	Phosphorus (ppm)	API	Type	Street price per quart	Cost for oil change
Mobil 1 MX4T	10W-40	1542	1344	SG	Synthetic	\$8.25	\$82.50
Royal Purple Max Cycle	10W-40	1222	4085	SJ	Synthetic	\$7.00	\$70.00
Redline	10W-40	1872	1440	SL	Synthetic	\$8.00	\$80.00
Svepco 306	15W-40	1476	1238	CI-4	Conventional [‡]	\$6.00	\$60.00
Royal Purple Max Cycle	20W-50	3907	1458	SJ	Synthetic	\$7.00	\$70.00
Mobil 1 V Twin	20W-50	1329	1949	SG	Synthetic	\$8.25	\$82.50
Brad Penn Grade 1 Racing	20W-50	1250	Not tested	SJ	Conventional [‡]	\$4.50	\$45.00
Svepco 306	20W-50	~1400	~1200	CI-4	Conventional [‡]	\$6.00	\$60.00
Mobil 1	15W-50	Unknown	1200	SM	Synthetic	\$6.00	\$60.00

Table 1 – Currently Available Oils with Proper Amount of ZDDP

If you are looking to research other grades of oil, www.lnengineering.com/oil.html is a wonderful resource put together by Charles Navarro. Most of the data in this document are based his lab results.

You can formulate your own oil by buying your favorite oil in the latest SM or CJ-4 spec and then adjust the ZDDP content with an engine oil supplement. The choice favored in the *Self Starter* article is GM EOS 1052367. This was discontinued during the summer and has been replaced by AC Delco EOS 10-106. The AC Delco product is reported to have the same formulation as the GM, but I have not seen any lab results as confirmation. STP Oil Treatment for four cylinder engines (STP Red) is a relatively inexpensive alternative. I would not recommend it for the simple reason that you would have to use four bottles to bring your oil up to snuff. At that point 20-25% of your crankcase would be STP rather than motor oil. (See Tables 2 and 3.)

Brand	Size	Zinc (ppm)	Phosphorus (ppm)	Street price per bottle	Comments
GM EOS 1052367	16 oz.	6221	5762	\$16	Discontinued, but still available.
AC Delco EOS 10-106	16 oz.	6221	5762	\$10-12	Replacement for GM EOS. Assumed to be the same formula.
STP Red	15 oz.	3932	2115	\$2.89	Need at least four bottles to raise zinc to 1,200 PPM in avg. SM oil.

Table 2 – Additives with ZDDP

API Rating	Average lab results		Predicted results with EOS added		Amount of additive to include in 9-1/2 qt. oil change. GM or AC Delco EOS (oz.)
	Zinc (ppm)	Phosphorus (ppm)	Zinc (ppm)	Phosphorus (ppm)	
CJ-4	1014	819	1562	1339	32
SM	939	770	1495	1295	32

Table 3 – Average Zinc and Phosphorus Found in Currently Available Oils and How to “Correct” Them

I talked to world-renowned postwar Rolls-Royce expert John Palma at Palma’s Automotive Services in Audubon, New Jersey. He indicated that they have seen cam wear issues on Crewe built Rolls-Royce and Bentleys and that they use Justice Brothers Oil Treatment when performing oil changes at the shop. I have not found any lab

[‡] highly refined paraffinic based petroleum oil, definitely not bargain basement stuff.

data on the ZDDP content of this product, but it may very well turn out to be an excellent alternative to AC Delco EOS. Stay tuned.

There are many permutations and combinations of oils and supplements. Table 4 boils down the data into three choices for 10W-40 synthetic lovers, two choices for 15W-40 diesel oil aficionados, three choices for 20W-50 fanatics and one for 15W-50 synthetic. Note that there are no Valvoline VR-1 picks on my list. VR-1 tested less than our borderline for zinc at 1085 ppm and the VR-1 NSL (“not street legal”) version has even less at about 840 ppm. If you don’t like my choices, there’s plenty of data on the LN Engineering website and elsewhere to formulate your own solution. And if you are wondering what my plans are: the 1939 Wraith and 1973 Silver Shadow will be switched over to Swepeco 306 15W-40 at their next oil change.

Oil	API	Viscosity	Supplement	Cost for 9-1/2 qt. oil change.	Comments
Shell Rotella T (8-1/2 qts.)	CJ-4	15W-40	AC Delco 10-106 (32 oz.)	\$54	Puts the ZDDP back into good 'ole Rotella.
Swepeco 306 (9-1/2 qts.)	SJ/CG-4	15W-40	none	\$60	Very high quality conventional motor oil, if you swore by CI-4 Shell Rotella T or Mobil Delvac Super 1300, this is even better. The BMW and Porsche guys love this stuff.
Royal Purple Max Cycle (9-1/2 qts.)	SJ	10W-40	none	\$70	Run full synthetic at a lower cost than Mobil 1 options below.
Mobil 1 High Mileage (8-1/2 qts.)	SM	10W-40	AC Delco 10-106 (32 oz.)	\$83	One option for Mobil 1 enthusiasts...
Mobil 1 MX4T (9-1/2 qts.)	SG	10W-40	none	\$83	Another option for Mobil 1 enthusiasts.
Brad Penn Grade 1 Racing (9-1/2 qts.)	SJ	20W-50	none	\$45	Brad Penn also offers 30W break-in oil, for those of you rebuilding older R-R six cylinder engines. Both oils highly recommended.
Royal Purple Max Cycle (9-1/2 qts.)	SJ	20W-50	none	\$70	Run full synthetic at a lower cost than Mobil 1.
Swepeco 306 (9-1/2 qts.)	SJ/CG-4	20W-50	none	\$60	Very high quality conventional motor oil.
Mobil 1 (9-1/2 qts.)	SM	15W-50	None	\$60	Exxon-Mobil recently published the ZDDP content of all their synthetic oils and this one is the only one they recommend for flat tappet engines.

Table 4 – Total Cost of Oil Change (Minus Filter)

At Sherbourne Mews, we set out to publish a little niche publication on Rolls-Royce Silver Shadows and perhaps manufacture a few unique automotive tools and the like. We didn’t set out to be in the oil business, but we are happy to give it a try. As of Oct. 18, 2007, you can buy cases of Swepeco 306 15W-40 and 20W-50 from us!

Good luck and happy motoring!

Jon Waples

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