

Oil Alert for Antique Auto Engines

There have been changes made to the formulation of motor oils that have a negative effect on our Model A engines. This article is intended to provide an overview of the problem and present possible solutions to prevent damage and to extend the life of our engines.

Until the late 1980's, oils contained significant amounts of an Extreme Pressure (EP) additive called ZDDP, which is zinc-dialkyl-dithiophosphate, a phosphorous-zinc additive that resists wear and galling at high pressure points in the engine; particularly at the cam lobe and flat-faced tappet, used in our Model A engines. The basic principle of lubrication is to maintain an oil film between moving surfaces. As long as an oil film is present, wear is not possible. The oil film will only be absent in one of the following two circumstances:

- * An improperly designed engine with high pressure loading that breaks the oil film,
- * During start up, before the oil has had enough time to reach every moving part;

If these circumstances didn't exist, anti wear additives wouldn't be required. Whenever the oil film is broken, the moving surfaces rub against each other and heat up. The components of ZDDP react to heat and stick to the heated surfaces, building up a protective film. Until then, it stays in suspension.

Within the last few years, problems with cam and flat-faced tappet wear are becoming increasingly more common in antique engines of many car manufacturers as the concentration of ZDDP has been gradually diminished.³ Modern engines use roller cams with lower contact pressures and reduced sliding friction than our flat-faced tappets and therefore can tolerate lower concentrations of ZDDP in the oil.

Oil Formulation Issues

The API (American Petroleum Institute) oil classification SH, obsoleted several years ago, was the last oil formulation that included adequate levels of ZDDP for our engines. Because of negative effects on catalytic converters, the EPA has mandated gradual reductions of ZDDP in oil classifications SJ, SL and SM such that these oils no longer provide the protection required to prevent cam, and tappet damage to our antique engines. [The API classification can be found on the cans or bottles of motor oils in the Starburst insignia]. Further, the current API oil classification SM, established in late 2004, is also formulated to produce less drag on the moving parts of the engine to increase gas mileage. This is accomplished by degrading the viscosity modifiers so that oil viscosity decreases within a relatively short time in use. As a consequence, this thinner oil can cause more wear than the older oil formulations.

The API classification SM is intended for passenger automobiles with catalytic converters. However, specialty oils such as racing oils are not required by the EPA to have lower levels of ZDDP. These oils typically include 1200-1600 ppm of ZDDP vs. 400-800 ppm, in the API-SM oils. Additionally, racing oils typically include more anti-wear additives and anti-foaming additives – the latter being an important oil additive for our Model A engines that have connecting rod dipper oiling that can be a foam generator.

What is the solution?

So, what oil can we use to provide the protection needed in our engines? Torco TR-1 50W racing oil has been successfully used in Model A engines for several years. It is a petroleum-based oil with various polymers and additives, including MPZ; a phosphorus-zinc-molybdenum additive for resisting wear at high pressure points and providing excellent sealing of the wide Model A rings. Even though it is an expensive oil at about \$7 per quart, with this oil we can increase our oil change interval from the usual 500 miles to about 2,000 miles.² This fact then makes it more price competitive with the standard oils that we have been using. But, also consider what a cam and set of tappets is worth.

In addition to sources on-line, this oil is recommended and sold by Piranio's Antique Automotive in Denton. Dennis and Beth Piranio are members of CCMAFC and can be contacted at (940) 382-2742.

There are other specialty oils such as Redline, Royal Purple, Penrite and Amsoil that appear to provide ZDDP in the proper quantities.⁵ Castrol has, within recent months, released their Syntec oil in 20W50 which is labeled "For Classic Cars" and contains the necessary amount of ZDDP. But the investigation of various alternative oils was not made for this article, primarily due to the lack of available information to analyze.

Also, it has been reported that some auto parts stores can obtain the older API formulations of oil that contain adequate levels of ZDDP.³ Some engine builders suggest the use of diesel oils such as Shell Rotella since it has, at least to date, maintained an adequate concentration of ZDDP. However, there have been reports of piston skirt scuffing and heavy sludge release when changing to this oil, because of its high detergent content. So, it appears that racing oils and older street-legal formulations prior to API-SJ are the safer oils to use.

Additives

There are also a number of ZDDP additives available to be used with your customary oil. Each will claim to have just what your car needs, and only time will tell if they solve the problem or amount to nothing more than modern day snake oil. Without a performance rating system, there is really no way to substantiate the claims of the manufacturers' marketing departments until your engine lives another 10,000 miles or packs it in. Additionally, there is the danger of getting too much phosphorous if the oil that you are using already has some ZDDP. Based on oil manufacturers test work, high phosphorous concentrations caused increased wear, and in some cases caused attack at the grain boundaries in the metal that resulted in camshaft spalling on the lobes⁴. So, putting an additive in your oil could be solving the problem or could be adding to the problem.

It would seem that using properly formulated oil is the safer route to take for your engine.

New Engine Issues

The availability of ZDDP in the oil is particularly critical on a new engine build. When an engine is first re-assembled, even with the most careful machining of the cam and use of the best-quality tappets, the rubbing surfaces are still pretty rough. Under a microscope, you would see high peaks and deep valleys in the metal surfaces. As the engine is broken in, those high peaks wear down from rubbing. But at the start, all of the pressure is concentrated on a very small part of the surface area -- the peaks. In addition, if the rebuild

process is done properly, assembly lube containing molybdenum coats the cam and tappet tips. This lubricates the surfaces until the high points can be removed, resulting in an extremely smooth surface.

And there, literally, is the rub. The process, which takes place primarily during the first few hours of the break-in period, but continues to take place for several thousand miles or hundred hours after that, requires one other ingredient. That ingredient is the ZDDP in the oil used during the break-in period which, in combination with the molybdenum-disulfide in the assembly lubricant, creates a continuously renewing metal surface in the low spots that helps spread the pressure. No ZDDP in the break-in oil, and/or the lack of an assembly lube, and instead of a smooth surface after break-in, the peaks on the surface of the tappet can literally weld themselves to the cam, causing pieces of the tappet surface to flake off, and making the lobe surface of the cam shaft ruinously rough.⁵ Early engine rebuild failures are now being reported, which are likely attributable to the lack of adequate ZDDP in the current API oil formulations.

Summary

There is no doubt that the problem of cam and tappet wear exists. It is also known that some percentage of the wear and failures can be attributable to the reduced levels of ZDDP in modern oil formulations. But, because of other factors related to the assembly and maintenance of an engine, no reliable statistics can be generated to truly define the severity of the problem that is related to reduced ZDDP. But, knowing that the potential for engine damage exists from oil formulation changes, it seems prudent to take the precautions that are readily available to us.

Bill R. Wittner
Cedar Creek Model A Ford Club
Mabank, TX
December 10, 2008

References:

² Piranio's Antique Automotive catalog

³ <http://www.macysgarage.com/myweb6/ZDDP.htm>

⁴ <http://www.zddplus.com/TechBrief2>

⁵ <http://healey.org/content/view/269/168/>