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ZPlus™ Tech Brief #6

Diesel Oil Use in Classic and High-Performance Gasoline Engines

Many people are pointing to diesel or heavy-duty oils as good replacements for the newer SM oils with reduced ZDDP levels. Many heavy-duty oils are sold as dual-duty oils, for both heavy-duty gasoline and diesel usage with a caveat: They are not intended to be used for vehicles manufactured after 1988 equipped with long-life catalytic converters.

An indication that the situation vis-à-vis EP (Extreme Pressure) agents in oil has changed can be seen by examining aftermarket cam manufacturer's current recommendations. Aftermarket cam manufacturers have always had to deal with a certain amount of failure due to incorrect lubrication at the time of assembly and resulting failure due to incorrect break-in. Even though they may have had to deal with this issue, the recommendation for oil to use after break-in was historically plain high-quality oil. Since 2001, with the introduction of SL and in 2007 SM oil, many have begun recommending the use of higher ZDDP oils such as certain diesel and heavy-duty oils.[1,2] Explaining why, they reveal they are dealing with an increased occurrence of cam failure in warranty. While, in general, they are quick to blame the situation on current oil formulations and lack of correct break-in, the situation is more complex. The past ten years has seen the rise of imported low-cost cam components into the U.S. aftermarket, and certainly some of the increased failures can be attributed to lower quality control on certain of these parts.

Regardless of the root cause, the fact that the cam manufacturers are placing increased emphasis on specifying oils with high levels of ZDDP underscores its importance to high-performance engines. So, what are the issues pertaining to the use of diesel-rated oils in an older gasoline engine with flat tappets?

1) Diesel oil is engineered with a higher amount of dispersant and detergent package to deal with the increased amount of soot and other hydrocarbon combustion by-products present in a diesel engine. This high amount of detergent can increase the decomposition temperature of the ZDDP,[3] which will reduce its effectiveness as an anti-wear agent, especially when a vehicle is used for short trips and does not achieve a full warm-up condition. Diesel engines are engineered with this constraint in mind, unlike gasoline engines.

2) Typically, the viscosity range for diesel oils does not include the very low 5W and 10W values or any EC (Energy Conserving) oils, limiting its use in a passenger car engine which calls for one of these EC oils. The practical downside of this is the loss of the 1.4% or more fuel savings (relative to non-EC oil) which the EC oils may provide. Also, there have been some engine designs recently with decreased main and rod bearing clearances. These engines are specifically designed to use the lower-weight EC oils, and may experience higher than normal bearing temperature due to insufficient oil flow, if the higher viscosity oils are used.[4] The bearing sizes and clearances in diesel engines are engineered with this in mind, unlike gasoline engines.

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[1] http://www.compcams.com/Technical/Instructions/Files/255.pdf
[2] http://www.cranecams.com/pdf/548e.pdf
[3] S.Shirahama and M. Hirata, Nippon Oil Co., Yokahama, Japan, "The Effects of Engine Oil Additives on Valve Train Wear," *Lubrication Science 0954-0075*, 383.
[4] B. Cockbill and J. Bennett, Ford Motor Co., "The Effects of Crankcase Oil Viscosity on Engine Friction At Low Temperatures," *SAE 2000-01-2052*.

3) Additives in oil displace the base oil which is the primary lubricant and hydrodynamic film agent. Some additives will even lower the film strength of the base oil. This is why relatively small amounts of additives are engineered into racing oil, where film strength is the number one design criterion. The bearing journal size-to-displacement ratio on a gasoline engine is designed around the use of lower-detergent oil and relies on a high shear rating of the oil. For a given viscosity, high-detergent diesel oil has a lower surface tension and lower shear strength which can cause increased bearing wear in high-revving gas engines. A diesel engine needs oil with very high-detergent capabilities in order to hold the large amount of combustion by-products in suspension. Diesel engine oil cannot be optimized for film strength due to this engineering compromise. On the other hand, high-performance gasoline engines *do* benefit from lower detergent oil which is more optimized for film strength than sludge and soot control.

4) The increased amount of metallic-based detergents in diesel oil can cause excessive ash deposits in the combustion chamber and on exhaust valves. In some worst cases, these deposits may cause detonation. This detonation could be potentially problematic, especially in high-compression, turbocharged or supercharged engines.

5) Use of this higher ZDDP content diesel oil gives better EP wear protection than SM oils for high-performance gasoline engines with high flat-lifter foot pressures, but small amounts of blow-by containing extra zinc and phosphorus can be detrimental to the life of catalytic converters. On the other hand, many performance enthusiasts feel they would rather protect the cam and lifter, even if the cost was a slightly reduced catalytic converter life.

In general, there are fewer choices for diesel-rated oil than for regular SM oils. This means that one may not be able to find the right combination of viscosity range, base stock (fossil or synthetic), or additive package in a diesel oil. There are a wide variety of high-quality SM oils manufactured these days, which are widely distributed and competitively priced. This gives you the best chance of picking the exact characteristics in the low-priced oil of your choice. You can add just a single 4 oz bottle of ZDDPlus™ to this oil to bring the EP characteristics to the level offered by the heaviest-duty oils made in the 1970's or 1980's. This approach represents the most flexible and least expensive way to get the proper oil for your classic or high-performance car engine.

This whole discussion may soon be moot. Newer diesel engines are being designed with catalytic converters and are required to meet even more stringent emission requirements. This is resulting in a further reduction of ZDDP levels in newer diesel oil.