

# ZDDP Engine Oil - The Zinc Factor

What You May Not Know About Today's Engine Oils Could Harm Your Vintage Mustang's Engine

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Photography by The Manufacturers, The Mustang Monthly Archives, Jim Smart

Engine oil seems so simple. It's slippery. It keeps metal parts from fusing together. It's messy, especially when it has been squeezed, slung, and sprayed around the inside of a hot engine for thousands of miles. And after it has been inside an engine for a few thousand miles, it seems dirty, worn out, and ready for disposal. But engine oil never wears out. It gets contaminated from combustion byproducts and it loses its additives to heat and pressure, which is why it must be changed from time to time. Otherwise, oil lasts virtually forever.

Oil is your engine's life blood. Not only is oil a lubricant, it is also a coolant as it transfers tremendous amounts of heat because it is in direct contact with the hottest components in your engine. Main, rod, and cam bearing journal temperatures can run upward of 400 degrees in normal operation. Conventional engine oil begins to break down around 260 degrees (synthetic oil is good up to 300 degrees). Above 300 degrees, engine oil begins to cook and stops being an effective lubricant. Oil survives the extreme heat because it keeps moving, getting rid of heat as it flows. This is why proper bearing journal clearances are crucial to engine survival. Oil must keep moving in order to both lubricate and transfer destructive heat.

One of the worst things you can do to your engine is start it. During those first few seconds of operation, there's no oil pressure at the bearings nor is there oil splash to lubricate other moving parts. Imagine crankshaft journals and bearings, not to mention piston rings and cylinder walls, getting together under high pressure before lubrication reaches them. This is where most engine wear comes from.

Lubrication is nothing more than a liquid wedge (cushion) between moving parts to prevent friction. But this alone doesn't guarantee success. Because liquid cannot be compressed, it is the perfect type of lubrication because it prevents metal-to-metal contact. When this film is pressurized, it creates a solid barrier between moving parts. Think of the liquid wedge like you would tires hydroplaning on wet pavement. Tires move over the surface without actually touching the pavement.

In theory, the liquid wedge should always keep moving parts apart. However, there are factors that can break down the barrier. And when this happens at high rpm, destruction can occur in a nanosecond. Extreme heat, which causes lubrication to break down, ultimately brings moving parts together to cause engine damage.

This leads us to the main point of this article--zinc, or more specifically the lack of it in today's oils. Oil companies started adding ZDDP (zinc dialkyldithiophosphate) to engine oil back in the 1950s to help reduce wear and tear during engine start-up. How important is ZDDP to your classic Mustang's engine? It reduces bearing and journal wear by a factor of 20. It's that important.

ZDDP acts as an anti-wear barrier with great staying power when we shut an engine down. It does essentially the same job tetraethyl lead did for exhaust valves and seats before it was removed from gasoline in the 1980s to reduce air pollution. Lead acted as an anti-wear element between valve and seat. When the Environmental Protection Agency (EPA) mandated lead's removal from gasoline, it caused quite a stir in the classic car community because enthusiasts feared excessive exhaust valve and seat wear. The solution was the installation of hardened exhaust valve seats in older iron cylinder heads.

According to the EPA and automakers, ZDDP deposits can damage catalytic converters in new cars, reducing their effectiveness as pollution control devices. The zinc bonds to the metal catalyst beads inside the converter, which undermines their purpose. For motor vehicles with catalytic converters (1975-up), it can mean increasing pollution levels from contaminated catalytic converters.



This is the first place oil arrives under pressure--crankshaft main bearing journals (except the 351C where cam bearings get oil first). Pressure must always be maintained during engine operation to keep a liquid wedge between journals and bearings. Rule of thumb is 10 psi of oil pressure for every 1,000 rpm. Oil pressure is lost when bearing/journal clearances become excessive. It also can become lost with excessive pump rotor clearances or defective pressure relief valve operation.



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Here's a connecting rod bearing that has suffered friction damage from oil wedge breakdown between bearing and journal. Heat has become extreme along the bearing's center. Once damage begins, it only gets worse. Material melts away under extreme heat and pressure.

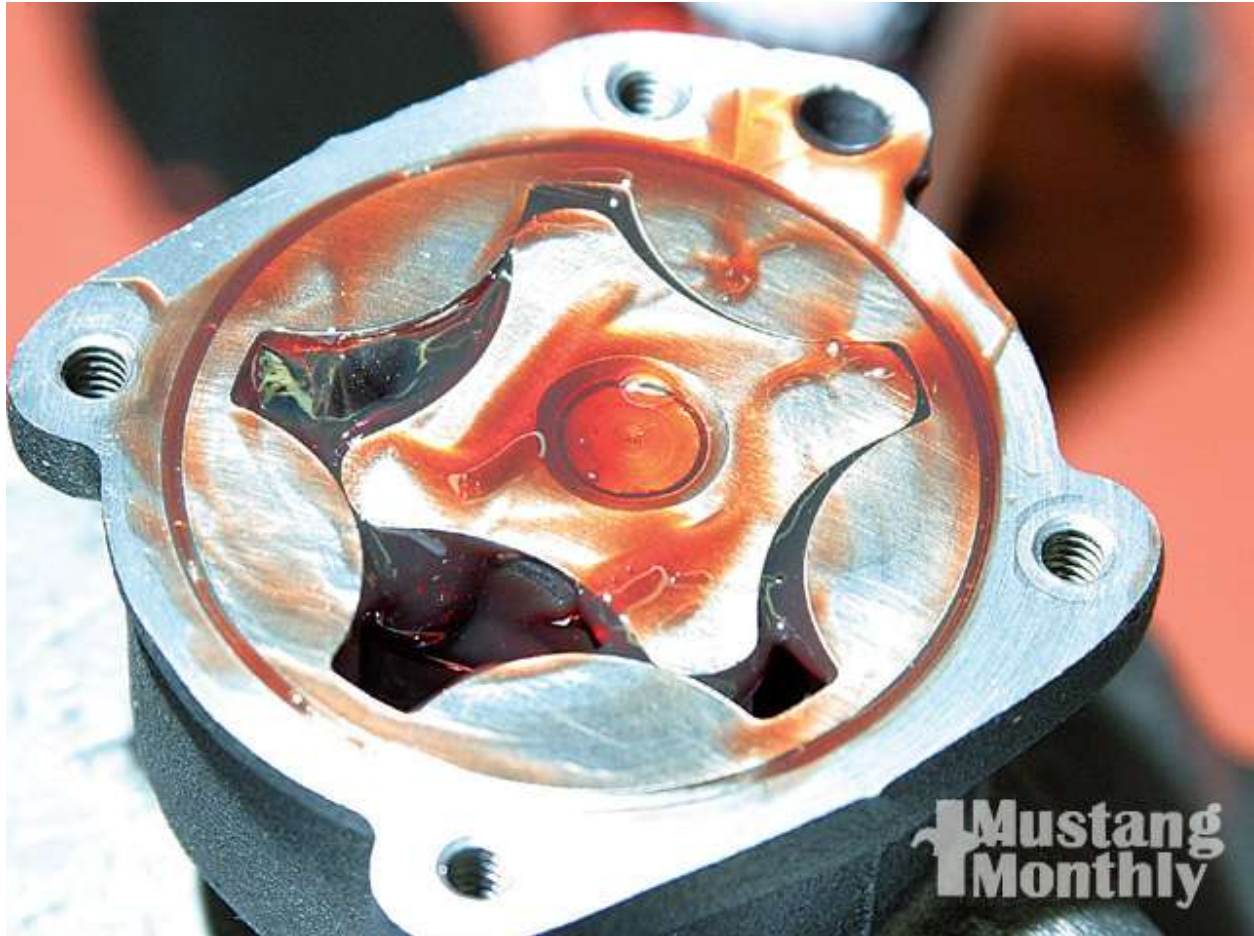


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This flat-tappet hydraulic camshaft has suffered the rigors of wear and tear. The journals appear to have had sufficient lubrication but the lobes are excessively worn. This is what the zinc issue is all about. Zinc has always been an engine oil additive designed to reduce engine wear.



Sufficient zinc levels in engine oil aren't just about flat-tappet engines, but severe duty as well. Zinc provides an important anti-wear barrier that racers need under grueling conditions.



All classic [Mustang](#) engines have positive-displacement oil pumps, also known as "G-rotor" pumps with a two-stage inner and outer rotor. The inner rotor is camshaft driven. The outer rotor rides on the inner rotor, with the two closing up and moving oil from the pan to the engine's oil galleys. Whenever you replace an oil pump or build an engine, pump cavities must be filled with SAE 30 weight oil or engine assembly lube to ensure pump priming for a healthy start up.



Your engine's greatest enemy outside of oil starvation is dirt--no matter how small. Look at the damage to this small-block Ford oil pump's rotors and cavity. The scoring lines were caused by dust and dirt that got into the oil.



Here's how bad foreign matter in your oil can get. Debris was drawn into an oil pump, causing the pump to seize, which sheared this shaft.



Marvin McAfee of MCE Engines suggests using a [powerful](#) magnet at the pick-up screen to keep ferrous metals out of the pump. Magnetic drain plugs are also an excellent idea because you can see ferrous metals, if any, during oil changes.



Which type of engine oil should you use and what viscosity? Freshly built engines should get a conventional, non-detergent, heavy-duty SAE 30 weight oil for proper break-in. Once the engine has passed 500-1,000 miles, you can run Mobil 1 10W30 or 10W40 synthetic along with a ZDDP additive. If synthetic is beyond your budget, choose Castrol, Valvoline, or Mobil 10W30 or 10W40. High-mileage engines that have had a diet of conventional oil need to stay with conventional oil, either 10W40 or 20W50.



Read carefully what's on the bottle. A "newer [vehicle](#) formula" means the oil probably doesn't include zinc. If you see "SM," that means low zinc or no zinc.



Conventional engine oils are the right choice for break-in and for higher [mileage](#) engines. Viscosity should be 10W40 or 20W50 for high-mileage engines. Aside from ZDDP, your engine oil doesn't need any other kind of additive.



ZDDPlus from Navone Engineering ([www.zddplus.com](http://www.zddplus.com)) is a very effective zinc-based oil additive that should be used right from the start with a new engine. It is also the most effective oil additive you can buy for older engines because it slows wear. You can get a discount when you buy a six-pack.