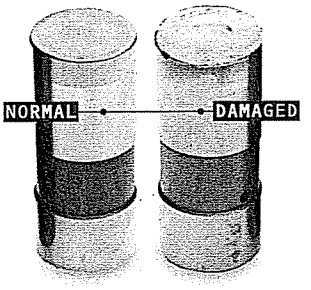
Car Clinic

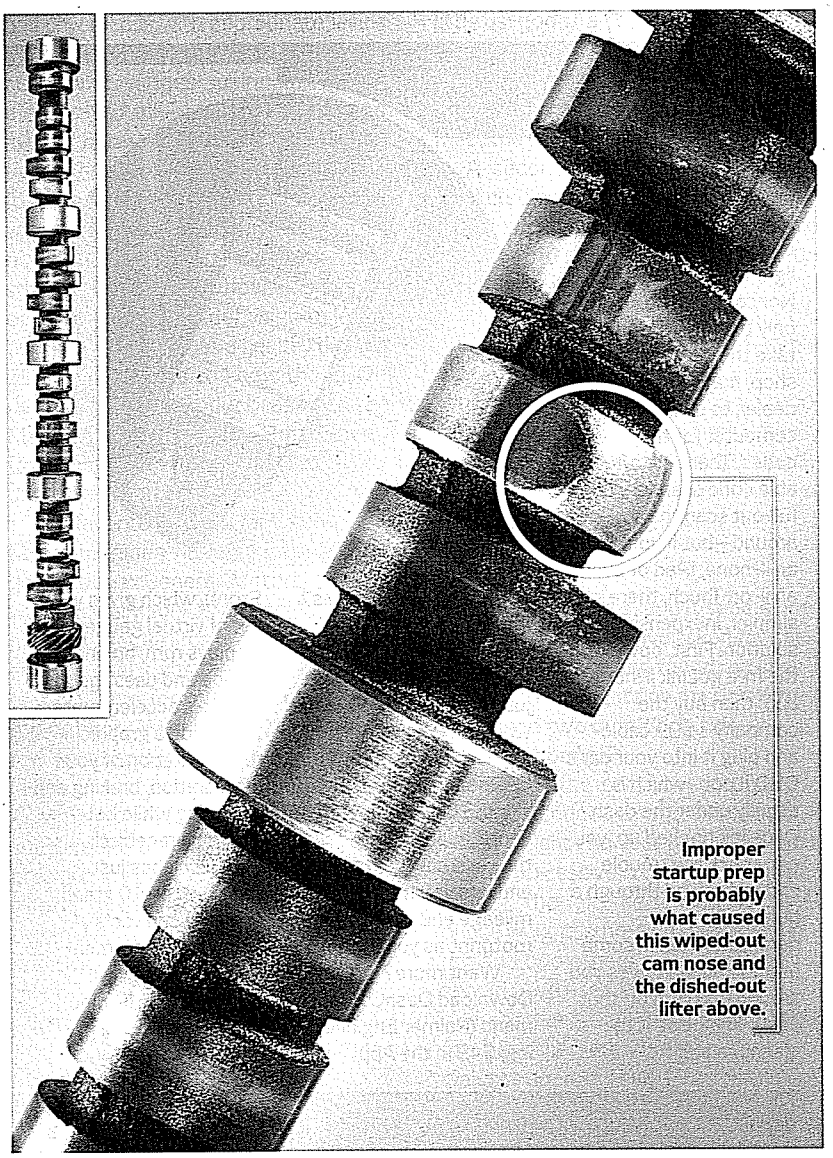
by Mike Allen

Q+A



The Missing Zinc

I had a local speed shop rebuild the engine in my classic muscle car to as near to the original specs as they could, including all-new valvetrain, pistons, rings and bearings. I prepressurized the oil system, and the engine started right up. Within an hour's driving, the engine started to lose power and misfire. One of the camshaft lobes had failed, making the egg-shaped cam virtually round. There was a big divot carved out of that lifter to boot. The shop says that I used the wrong oil and that I should have used a zinc additive as well. I used a premium oil, the same one I use in my new car.



Improper startup prep is probably what caused this wiped-out cam nose and the dished-out lifter above.

STUDIO D

A Ah yes, the missing zinc. Let me start with a primer on zinc/phosphorus antiwear additives: In the '50s, when cars began to feature overhead valves and started making serious horsepower, the camshafts needed more aggressive profiles, which were prone to rapid wear. That's when lubrication engineers discovered the utility of zinc dialkyldithiophosphate (ZDDP), which had previously been used in motors as an anticorrosive additive in modest quantities. The phosphorus and zinc in this molecule are attracted to bare iron, coating the microscopic asperities (high spots) where the cam nose slides over the flat surface of the tappet. This molecule-thick layer prevents iron-to-iron contact. After a few hours of operation, the two surfaces burnish each other to a nice, smooth, low-friction surface, microwelding is a thing of the past, and everybody's happy. Without the zinc and phosphorus, this localized high pressure, combined with the sliding friction, can microscopically weld the cam to the lifter, ripping out tiny chunks of metal. The industry standardized on 800 or so parts per million (ppm) ZDDP content in motor oil, and engines lasted a very long time. In fact, ZDDP levels eventually rose to 1200 ppm by the '70s.

Cut to the 1980s. Cars universally have catalytic converters installed to meet emissions requirements. Somebody figures out that zinc and phosphorus can contaminate the precious-metal reactor beds in the cats, reducing their

PHOTOGRAPHS BY **PHILIP FRIEDMAN**

effectiveness. Concurrently, in an effort to reduce internal friction and improve economy, more and more engines use roller tappets or roller rockers, eliminating sliding friction at the camshaft–lifter interface. Even engines that have non-roller-bearing camshafts have better, upgraded metallurgy and improved surface finish at that critical cam lobe–lifter interface. ZDDP levels were reduced to 1000 ppm, because higher levels were no longer deemed necessary.

Now it's 2010, and emissions requirements are even stricter. ZDDP levels have been reduced back to 800 ppm in the latest generations of motor oil, API's (American Petroleum Institute) SM and ILSAC's (International Lubricant Standardization and Approval Committee) GF-4 spec. Even if some oil gets past the rings or the valve-stem seals in your engine and is drawn into the intake through the PCV (positive crankcase ventilation) vent, the cat will remain pristine and your exhaust will smell like buttercups.

And this is right where your '60s muscle car gets the shaft. Too little ZDDP, especially in the critical first few minutes of engine operation, can destroy the surface finish of the cam lobes and lifters, especially on the high-lift cams, factory or aftermarket grind, used on the really fun cars. Lubrication

TOOL OF THE MONTH

Scan This

Sooner or later, everyone who owns a car has it happen: The dreaded Check Engine light comes on. Noncognoscenti know only that they'll need to take the car to a repair shop, maybe even to the dealer, to scan the computer for trouble codes. There are affordable code scanners and full-out scan tools around—but if you've got an iPhone, iPad or even an iPod Touch, there's a simpler, inexpensive solution. First, download the free goLink iPhone app, then buy the company's $99 cable and plug it into your car's OBD II port, which is usually under the dash. Once it's hooked up, you can check the trouble codes, browse through a bunch of engine parameters while some faithful minion drives you around and turn off that pesky light. Use it to diagnose and fix something as simple as a loose gas cap and you can recoup the cost of the cable by eliminating just one service call. But wait, there's more! The cable also works with CARbonga (Speedemissions; $4.99 in the App Store), which checks all the car's safety systems and lets you monitor fuel mileage and carbon footprint as you drive.

Want more? Download DashCommand (Palmer Engineering; $49 in the App Store), which gives you a set of virtual gauges, displays rpm, hp and torque and uses the iPhone's accelerometer to provide a graphic representation of your acceleration, braking and cornering while hot-lapping a racetrack.

GoLink has just replaced the 10 grand or so of scan tools—and all the equipment I lug around to test cars—with an iPhone and a cable. I hate it. I love it. —*M.A.*

PHOTOGRAPH BY DENNIS KLEIMAN

engineers at Shell say that a stock engine with the original camshaft grind, stock springs with modest seat pressures and OEM-ratio lifters should be fine running these 800-ppm oils. Aftermarket grinds, stiff springs and high-ratio rockers increase cam-to-lifter pressures and would be better off with higher levels of ZDDP in the mix. Regardless of the petroleum companies' take on this, most engine builders specializing in these specialty cars like to see that 1200-ppm number.

Back to your problem: Your engine builder should have provided you with instructions as to what oil to use, because there are options. Several companies make boutique oils that meet that high-zinc spec of yesteryear. Amsoil has several oils with appropriate levels of ZDDP in viscosities correct for your car. Some suggest using a modern diesel-rated oil—which I recommend against because there are a lot of additives in diesel oil that aren't appropriate for spark-ignition engines, and vice versa. If you can't find anything better at Walmart, however . . . Many mainstream petroleum companies have an oil marketed for older, high-mileage cars, and it usually has a healthy dose of ZDDP. If you need to know the ZDDP content of any product, ask for the MSDS (Material Safety Data Sheet) from the supplier, which will list everything in the bottle.

My favorite solution for veteran flat-tappet engines has been around for generations: General Motors' EOS. It was originally sold as an engine oil supplement (get it?) for high-performance engines, and it has the correct amount of ZDDP in a form that won't plug up the oil filter. GM dropped this product a few years back, and I was hoarding my last six cans. Then it returned as EOS Assembly Lube, not recommended as a supplement for routine use, but only for breaking in a new engine. If that's what it takes to get it past the EPA and onto the shelves, fine. There are other ZDDP additives on the market as well. My favorite is Comp Cams' Break-In Oil Additive, coupled with the use of GM's EOS or Comp Cams' Cam and Lifter Installation Lube.

One final thought: It's easy for the engine shop to blame the oil, but there are plenty of other potential issues that can wipe a cam nose. I like to assemble high-performance engines that have stiff springs, lots of seat pressure and high-lift cams a little differently. I leave out the inner valve spring and even substitute lower-ratio rocker arms for the first few hours. This will substantially reduce cam-nose-to-lifter pressures, reducing wear. After a few hours at lower revs, I change the oil to get out all the wear metal and install the rest of the springs and the correct rockers. By then, the cam and lifter interface has been broken in properly.

One important caveat: Do not add extra ZDDP additives to an oil that has sufficient ZDDP already on board, in the time-honored American tradition of "if a little is good, a lot more is better." Excessive ZDDP is corrosive, and the optimal level is right around the 1200-ppm point already in most oils that meet the older standards.

A second important caveat: Oils marketed as racing oils may have a different additive package and may have less detergent, dispersant, viscosity-index improver and other good stuff in them. They're really intended for racing, and their short drain intervals make them unsuitable for street-driven vehicles. To confuse the issue, some products labeled as racing oil may actually contain the appropriate additive package and would be suitable for street use. Castrol GT Racing is one.

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