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Risk vs. Reward

When it Comes to Oil Pumps, Knowing Whether to Reuse, Rebuild or Replace Can Be a High Pressure Proposition

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Most engine builders appreciate how important good oil pressure is for proper engine lubrication and longevity. They also know that low oil pressure can cause engine noise, bearing failures and customer complaints that result in an expensive warranty claim.

Considering how important oil pressure is for all of these reasons, why would anyone take a chance on reusing a high mileage oil pump when rebuilding an engine?

Old oil pumps are usually worn pumps with sloppy internal clearances and reduced output. Wear between the gears, the gears and the housing, and the gears and the pump cover provide leak paths that can hinder a pump's ability to generate normal flow and pressure. Pulling the cover off the pump and sanding or grinding it flat can help tighten up the end clearance between the gears and cover, but it won't do anything to restore

clearances between the gears or the gears and the housing.

The pressure relief spring in a used pump can have millions of compression cycles already applied and if reused will run a high risk of failure. A broken spring will allow the pressure relief valve to stay open, greatly reducing the flow output of the pump.

Front-mounted pumps, which are driven by the crankshaft, have machined features called sacrificial nodes or a ring. Those features are used to center the pump to the crankshaft at the engine assembly plant. Due to the design, these will become partially deformed by the crankshaft (hence the term sacrificial) during normal engine operation. So a used oil pump will have these centering features deformed, which will make centering the pumps to the crankshaft very difficult if not impossible.

Racers will sometimes "blueprint" an oil pump to minimize internal clearances because close tolerances increase pump efficiency and output. However, this involves select fitting the gears to each other and the pump housing, which requires a supply of parts that can be mixed and matched to achieve optimum clearances.

One of the risks of rebuilding or blueprinting an oil pump is getting it too tight. Metal shrinks when it is cold, and expands when it is hot. Consequently, if a pump is built for optimum clearances when it is hot, it may be too tight and bind up when the engine is cold.

According to one aftermarket supplier, a brand new quality-made small block Chevy spur gear oil pump should have about .003" of clearance between the gears and housing. Backlash between the gears should not exceed .007 to .008". The pump should also have about .003" of clearance between the gears and the pump cover. Some pumps, even brand new ones, will have more clearance than this. Maximum clearance between the gears or pump cover should not exceed .005 to .006" because it will reduce pump efficiency, oil flow and pressure. High mileage used pumps can have even greater clearances. That's why no engine builder worth his salt should reuse or attempt to rebuild a used, high-mileage oil pump. The cost savings are not worth the risk.

A brand new oil pump is just as important as new bearings, rings, gaskets and timing chain or belt. Most brand name pumps will have the proper clearances out of the box. Even so, it's always a good idea to



A front mounted oil pump may be damaged if it is not centered correctly on the crankshaft.

disassemble the pump and check internal clearances with a feeler gauge prior to installing the pump to make sure the clearances are correct. If a pump has too much clearance, take it back and get another – or try a different brand. But be sure to reinstall the gears and rotors just as they were removed from the pump. Some internal pump components are not symmetrical and if miss-installed will lock-up when the cover screws are torqued to the proper specification.

Something else to keep in mind with respect to new pumps is that disassembling the pump will void the factory warranty!

OIL PUMP UPGRADES

For a performance engine build, upgrading to some type of performance pump is usually a good idea. It might be a high-volume pump and/or a billet pump for added strength and durability.

Many engines don't need a high-volume pump because a stock pump will usually generate enough flow and pressure, but there are exceptions. Engines built with looser bearing clearances, piston oilers and/or extra oil lines for upper valvetrain roller rockers or shaft rockers will require a higher volume pump. The same goes for late-model production engines that have cylinder deactivation and/or variable valve timing. They also require higher-flow oil pumps.

Don't confuse high volume with high pressure. High pressure just means the pump's relief valve has a stiffer spring that requires higher system pressure to operate. Once the pressure is obtained some of the output oil flow will be re-routed back to the inlet of the oil pump.

Most engines only need about 10 psi (or less) of oil pressure for every 1,000 RPM, and many engines can get by with as little as 5 to 7 psi per 1,000 RPM.

A key point to keep in mind with respect to pressure is that higher flow rates and the resulting pressure uses more horsepower. That's why NASCAR engine builders try to minimize oil pressure as much as possible to squeeze every last usable horsepower from the engine.

Oil pumps can use quite a bit of power, especially at higher engine speeds – as much as 2.5 to 5 percent of the engine's output! That's quite a power drain, so some late-model engines are now equipped with energy-saving variable displacement oil pumps. A conventional, fixed-displacement oil pump churns out the same volume of oil regardless of how much the engine actually needs. Its output is directly proportional to engine RPM, and goes up with speed.

By comparison, a variable displacement pump has a vaned rotor mounted on a crankshaft driven eccentric. It works much like a variable displacement A/C compressor. The vanes rotate and sweep oil from the inlet side to the outlet side. By changing the relative position of the eccentric inside the rotor, or by rotating the outer housing, the relative volume on the inlet and outlet sides of the rotor can be changed to vary the pump's output. The pump may be spring-loaded to vary pressure, or controlled by the engine computer via an external solenoid. The latter uses a pulse width modulated signal to fine tune the pump's output.

A high-volume oil pump is one that flows more gallons per minute of oil (from 10 to 25% more) than a standard oil pump. A high-volume oil pump will have taller gears, and often larger inlet and outlet ports in the pump housing. The ports may also be blended and shaped to reduce



High-mileage oil pumps usually have a lot of wear inside, that's no surprise. But some brand new pumps can also have excessive clearances. Always check clearances to make sure they are within tolerances before installing the pump.

turbulence for better flow.

Some high-volume pumps have helical cut gears rather than straight cut spur gears. Helical gears have a sliding action as they mesh. This reduces pressure pulses from the pump that can have an adverse effect on the distributor drive and ignition timing. Pressure pulses from the oil pump can cause ignition timing to vary several degrees (a condition known as "spark scatter"), which can reduce high RPM power in a performance engine.

Gerotor pumps have a pair of lobed rotors inside the housing. The inner rotor has one less lobe than the outer rotor. As the inner rotor turns, it also causes the outer rotor to spin inside the housing, and the difference in volume between the rotors pushes the oil through the pump.

Gerotor pumps are often capable of higher flow rates than pumps with counter-rotating spur gears. Most front-mounted oil pumps are a gerotor design for this reason. The problem with front-mounted gerotor pumps is that they are mounted high and dry and further from the oil supply in the pan. This causes these oil pumps to be slower to self-prime following a cold start. Also, internal tolerances must be tight to assure good oil flow and pressure. The aluminum or stamped steel covers on some OEM front-mounted oil pumps experience quite a bit of flex under pressure. This can cause oil pressure to fluctuate or even drop at higher engine speeds. Aftermarket replacement pumps for many of these applications have more rigid cast iron covers to improve pressure tightness and priming.

IF OIL PRESSURE IS LOW

If a customer complains that the engine you built for him is not developing good oil pressure, any of the following could be a contributing factor:

- You cut corners and reused a worn, high-mileage pump – big mistake! Now you'll have to replace the pump at your own expense!
- You installed a new pump, but did not check its internal clearances to

to the bottom of the oil pan is too large, the tube may be sucking air instead of oil when the vehicle is cornering, accelerating or braking. Likewise, if the pickup tube inlet is too close to the bottom of the oil pan, it may be restricting oil flow into the pump.

- **Wrong oil pan.** If an engine with a wet sump oiling system is losing oil pressure when cornering hard, accelerating or braking, but develops

normal pressure the rest of the time, it needs a better oil pan to better control the oil returning to the pan. There are pans available with a windage tray, which will actively scrape the oil from the crankshaft.

They may also have internal baffles, side kickouts and/or a deeper sump to prevent oil from sloshing away from the pump pickup. The other option is to upgrade to a more expensive dry sump oiling system that can provide good oil pressure in spite of the driving dynamics.

Dry sump systems vacuum all of the oil from the pan and route it to an external reservoir so the pump always has a steady supply of oil.

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PUMP REPLACEMENT AND PRIMING

Crankcase-mounted oil pumps are usually self-priming because they are submerged in oil inside the pan, but front-mounted pumps are mounted high and dry and typically take longer to self-prime. Both types of pumps should be presoaked in oil before they are installed. Equally important is pressure priming the engine's oil system prior to its first start up.

Front-mounted pumps also require carefully centering the pump on the crankshaft before tightening the pump's mounting bolts to the block. If the pump is off-center, even slightly, it may bind up and fail when the engine is cranked or started.

One way to center a front-mounted oil pump is to install the pump on the block with the mounting bolts finger tight. Then crank the engine over several times so the pump can center itself on the crank. The pump mounting bolts can then be tightened to final specifications.

Another method for centering the pump to the crankshaft is to stand the engine block up on end. This will center the crank in its main bores. The front-mounted pump can then be mounted and centered using a feeler gauge before tightening down the bolts.

Finally, many experts warn against reusing high-mileage oil pickup tubes and screens. Why? Because they are difficult to clean internally and there may be debris left inside. Any debris lurking inside the tube or pickup will be sucked right into the pump if it comes loose. In addition, varnish buildup on the wire mesh reduces the effective open area of the pickup, which will impact the amount of oil flow through the wire mesh. A varnish coating of .005" can reduce the open area by 25%. ■