

Wet & Dry Sump Oiling Systems

Choosing the Right System for the Right Job

By Larry Carley, Technical Editor
lcarley@babcox.com

If you are building a customer's "dream engine" what type of oiling system should you use? The answer to that question will depend on the application (street, drag, circle track, road race, off-road or marine), engine RPM and how much your customer is willing to invest in a lubrication system.

Your choices may also be limited by track rules that restrict what type of oil pump or oiling system is allowed. A lot of dirt tracks and road courses don't allow dry sump oiling systems in entry level and stock

classes to keep costs down.

Regardless of what type of oiling system you and your customer ultimately decide upon, don't cheap out to save money. A customer who has already spent a ton of money for block work, pistons, rods, heads, valve work, a forged crank or stroker crank, balancing, a hot cam, lifters and valvetrain may feel like he's spent enough already and might try to pinch pennies when it comes to the oiling system. Bad mistake! The oiling system is not an afterthought. It's the key to protecting all of these other components and keeping them lubricated.

A stock wet sump oiling system with a stock oil pump and stock oil pan are usually adequate for everyday driving, but not much more. If an engine is being built to rev higher, make more power and accelerate a vehicle faster, the stock oiling system may run out of pressure at the worst possible moment.

The same risks hold true when brakes are modified to increase stopping power, when chassis are modified to enhance cornering agility and the stock tires are replaced with soft race compound rubber. As fore, aft and lateral G-forces increase, oil slosh inside the pan may be so severe that

the pickup starts to suck air, which leads to a sudden and precarious drop in oil pressure. If the situation isn't remedied almost immediately, it can be bad news for the rod and main bearings. Consequently, it's essential to make sure the oiling system's capabilities match the application.

Street Performance Recommendations

Street performance is normally not that demanding, but it can be the equivalent of drag racing or road racing depending on what's happening at any given time. Most stock oil pans can handle "normal" acceleration, deceleration and cornering forces without starving the pump. But as G-forces in any direction go up, so do the changes of sucking air into the oil pump's pickup.

A recommended upgrade for a wet sump system would be to replace the stock oil pan with a good quality aftermarket performance oil pan. Performance pans have better baffling to reduce oil slosh so the pickup will stay submerged in oil. A deeper sump also helps (assuming there is clearance for such) and increases total oil capacity (which helps the oil run cooler and last longer).

Watch out for cheap knock-off oil pans that don't have proper baffling and are made of thinner gauge steel. They may not provide the oil control you need, and if made to poor quality standards may be hard to seal. Installation may also be an issue on some applications due to bolt hole



Dry sump systems with multi-stage suction pumps pull oil out of the crankcase, separate oil and air and maintain a steady oil supply to the engine.

misalignment.

Cast aluminum pans with fins can provide some additional cooling benefits and will enhance the appearance of the engine. Just remember that aluminum is brittle and may crack and leak if you hit something, whereas a steel pan will dent.

For more serious street performance applications, one aftermarket oil pan manufacturer recommends replacing the stock oil pan with a road race pan. A road race pan is designed with baffles and trap doors to limit oil movement in all four directions.

Another must upgrade for every wet sump system is some type of windage tray or scraper to keep oil away from the crankshaft. A windage tray will reduce drag on the crankshaft and oil aeration, both of which are good for making more power and improving lubrication.

As for the oil pump, a stock pump

can usually provide adequate oil pressure for an engine that won't turn more than 6,500 RPM – provided it is a low mileage pump with normal clearances, not an old high mileage pump with lots of internal wear. So at the very least, a new oil pump is always recommended.

The output of many stock spur gear style pumps starts to flat line around 6,000 RPM. As the gears spin faster and faster, oil flow into the spaces between the teeth can't keep up and the pump starts to cavitate. Gerotor pumps are a little better in this respect and will handle somewhat higher RPMs before they start to flat line. But eventually, all stock pumps reach a limit.

Cavitation is the formation of little bubbles on the trailing edges of the gear teeth inside the pump. Cavitation is bad news because it aerates the oil and



Aftermarket performance oil pumps come in different designs and configurations for different applications (courtesy of Schumann Sales & Service)

causes a drop in oil pressure. Thinner oils such as 5W-20 and 0W-20 resist cavitation better than thicker oils such as 15W-40 because the lower viscosity allows the oil to flow more easily through the pump at higher engine speeds.

If a stock oil pump can't match the

AMERICAN-MADE

OIL PUMPS

FOR YOUR DIRT CAR!

Our Performance pumps are designed, engineered, and manufactured in the USA.

The other guys can't always say that.

Learn more at MELLING.COM/ENGINEBUILDERMAG

The first 25 visitors will receive a **FREE** metal shop sign!



2620 Saradan Dr. | Jackson, MI 49202
800-777-8172 | melling.com



engine's RPM potential, it needs to be upgraded to some type of aftermarket performance pump. There are many different pump designs to choose from, with various design features and benefits. The key difference is that a performance oil pump is engineered to flow more oil and to maintain pressure at higher engine speeds. Such pumps typically have redesigned inlet and outlet ports to improve flow and reduce cavitation, tighter internal clearances to reduce pressure losses, and more reliable and adjustable pressure relief valves. Some cast iron pumps may be made from a stronger alloy for added strength and wear resistance, while aluminum pumps are usually hard anodized to minimize wear. The stock pump cover may also be replaced with a stronger and harder cast iron or steel plate.

Some aftermarket pumps feature

unique gear designs, such as helical gears rather than straight cut spur gears. Slanting the gear teeth improves flow 5 to 10% according to one manufacturer, while reducing pressure fluctuations at the pump's outlet port. That, in turn, can reduce ignition timing changes (spark scatter) in engines with a distributor. Gerotor style pumps do the same thing (smoother output with less pressure pulsation).

Some people think you have to go nuts with oil pressure to prevent the engine from running out of oil. Not true! Most engines don't need more than 10 PSI for every 1,000 RPM. More oil pressure just means more horsepower loss unless there is a need for such (like piston oilers or separate oil lines to the upper valvetrain). In fact, reducing oil pressure a few PSI can actually gain a few horsepower by reducing the oil

pump's load on the engine. Changing the pressure relief springs in the pump can fine tune the pump's output to better match the application.

High volume oil pumps with longer (taller) gears are a popular upgrade to increase oil flow (typically 15% or more) if the engine really needs it. A high volume oil pump is recommended if the engine is being built with "old school" clearances and will be run on a heavier viscosity motor oil. Otherwise, a stock pump should provide adequate pressure and flow.

On certain late model applications such as Ford's modular V8 and Coyote V8, Chrysler's Hemi and Chevy's LS, a high volume oil pump may be required if the engine is equipped with Variable Valve Timing (VVT). The cam phasers in these engines need a lot of flow to function properly (unless you are locking out the phasers to accommodate a high lift, longer duration cam). A high volume pump can also help reduce upper valvetrain noise on some of these engines (such as Ford 4.6L V8s).

Something else to keep in mind with respect to front-mounted oil pumps on late model engines is that the pumps can be hard to prime. They are mounted high and dry, and a long ways from the pickup inside the oil pan. Never install one of these pumps dry. Fill it with assembly lube or heavy oil. Also, use a pressure oiler to pre-lube the engine before cranking it over for the first time. If this isn't done, you may end up with a dry start and pump and/or engine damage as a result.

Billet pumps are the ultimate upgrade for a wet sump system. Billet pumps are custom made and optimized with larger ports and taller gears to increase flow and resist cavitation at high RPM. The stronger housing (such as 6061 T6 aluminum) and larger mounting bosses is also better able to resist cracking from engine vibrations and loads. Most billet pumps are a bolt-on replacement for the stock pump, but may also require a special pickup and matching oil pan. They're also much more expensive than



PRO/CAM
RACING ENGINE COMPONENTS
Pro/Cam by Baker Engineering Inc. Nunica, MI

EXPECT MORE
From your oil systems & fuel pumps

For demanding high performance engines, and for customers who expect more, offer Pro/Cam engine components.

Designed by race engine builders for high performance engines, Pro/Cam wet sump, dry sump and custom oil systems are designed to manage oil flow better. The result is lower oil temperatures, more consistent pressure and horsepower gains. Pro/Cam also offers the most reliable mechanical fuel pumps on the market today for small block Chevy and Ford, big block Chevy and marine applications.

To see full line of Pro/Cam products, visit our website. To order, contact your distributor, or call direct.
www.BakerEngineeringInc.com 616-837-8975

circle 38 for more information

cast pumps because of the CNC machine work required to make the pump.

Circle Track

Pretty much everything that goes for street performance also applies to circle track, except that circle track cars are always turning left. Consequently, if the engine is running a wet sump system, you need an oil pan with a kickout on the right and relocated pickup to the right rear corner of the pan to keep the pickup submerged in oil.

Baffles and trap doors inside the pan are absolutely essential to keep the oil where it belongs. A cornering force of 1 G will cause the oil level inside the pan to assume a 45-degree angle. This also requires a windage tray to keep the oil away from the crank.

If rules allow non-stock parts, a performance oil pump or billet pump should be used to help assure good oil flow at high RPM. Use the largest pickup tube available to raise the point at which pump output flat lines. The pickup box or screen should also be low restriction so it doesn't inhibit oil flow at high RPM.

Another option for upgrading a wet sump system is to go with a belt-driven external oil pump. Relocating the oil pump from inside the oil pan to outside on the engine makes pressure relief valve tuning easier. It also allows a shallower oil pan so the engine can be mounted closer to the ground for a lower center of gravity, improved handling and better aerodynamics. Although rarely used on the street, this type of setup is a good alternative for circle track and road racing applications – if the rules prohibit a dry sump system.

An oil accumulator is also a good addition to a racecar oil system. An accumulator will store oil pressure so the oil pressure doesn't drop under hard acceleration, braking or cornering. The accumulator can also provide initial oil pressure when cranking the engine to prevent a dry start. The accumulator can be set up with a ball valve to control pressure flow in and out of the unit, or an electric valve and pressure switch that



Gerotor pumps are more cavitation resistant than straight cut spur gear pumps and produce fewer pressure pulsations (courtesy of Schumann Sales & Service).

only opens when pressure drops below a certain threshold.

If class rules allow a dry sump system, it's well worth the extra money to go this route. A dry sump system eliminates oil slosh inside the pan by sucking the oil out of the pan. This, in turn, eliminates the need for baffles and trap doors and kickouts to control oil slosh, and allows a shallower pan so the engine can be mounted lower in the chassis for handling and aerodynamic advantages.

A dry sump system (when properly installed) also eliminates worries about oil aeration, pressure loss and starvation. As suction pumps pull oil from the crankcase, the oil is routed into a tank that allows the air and oil to separate. The tank also functions as an oil reservoir, increasing the overall oil capacity of the system as it supplies the external pump with a steady supply of oil.

Dry sump systems can also pull vacuum inside the crankcase if they have enough suction pumps (usually three or more are required). This can reduce drag on the crank for more power (5 to 15 hp). To realize such gains, the suction



ENGINE SLEEVE SOLUTION SPECIALISTS

IRON & ALUMINUM BLOCKS

STREET - DRAG - ROAD RACE - FI - CUSTOM

Saving Cylinders for 70 Years.

- Maintain aluminum block integrity. Boost ranges up to 92lbs. Horsepower rated up to 1,000hp. Ideal for boosted Turbo and Nitrous motor builds.

- **For Amphibious ProCross** – ProCross design features will dry press in seconds, prevent beam movement and leakage, and sustain the proper cooling flow.

- **American Made Since 1945** – our sleeves are created from our proprietary MOLYDINO centrifugally spun-cast ductile, providing greater micro-structural density than our competitors.



SCAN THE CODE TO LEARN MORE & SEE THE VIDEO



13051 Rivera Road, Santa Fe Springs, CA 90670
562.945.1528 Toll Free: 800.822.8005
www.lasleeve.com • info@lasleeve.com

circle 39 for more information

Oiling Systems

pumps have to pull at least 8 to 10 inches of vacuum. Pulling additional vacuum with additional suction pumps (four, five or six) doesn't make more power unless the engine is revving beyond 8,000 RPM.

Besides the cost of the hardware (which can range from \$3,000 to \$7,000

or more depending on the setup), a dry sump system also requires a lot of external oil plumbing. This increases the chance of oil loss should a hose or connection fail.

When setting up a dry sump oiling system, you want just the right amount

of suction and oil flow. Too much suction or too much oil flow and you are just wasting power. Too much pressure can also raise oil temperatures. Using an oil flow meter in the oil supply line can help you determine the optimum pump size that works best. Oil flow requirements can vary depending on oil viscosity, main and rod bearing clearances, and the lubrication requirements for the rest of the engine.

A dry sump system on a circle track car should also have an oil cooler to keep oil temperatures within a safe range for the duration of a race.

Road Racing

Everything that applies to circle track also applies to road racing, with the exception that road race cars turn in both directions, not just left. Because of this, a wet sump system requires a road race oil pan with a center located pickup and baffles and trap doors around the pickup that control oil motion in all four directions. Better yet, go with a dry sump system to eliminate oil slosh and aeration entirely, plus the lower engine location, lower center of gravity and improved aerodynamics.

Off-Road

The same dynamic forces that act on the oil in a road race engine also apply in an off-road engine, with the addition of vertical forces that can occur if the vehicle goes airborne. Flying over a hill can literally suspend the oil in mid-air inside the pan. No amount of baffling and trap doors can keep oil around the pickup under these conditions, so you either need a backup oil accumulator to maintain pressure or a dry sump system. As with circle track and road racing, an oil cooler and plenty of reserve oil capacity is required to keep oil temperatures within a safe range for long distance races.

Drag Race

Many people think drag racing is only straight line acceleration, so the only worry is preventing the oil from

GIVE YOUR ENGINE THE LIFTER IT NEEDS TO REACH ITS POWER POTENTIAL!



A-2348SE RETROFIT LS LIFTER

OUR DIRECT-SHOT OIL INJECTION SYSTEM DELIVERS A CONSTANT SUPPLY OF PRESSURIZED OIL DIRECTLY TO THE NEEDLE BEARINGS WHICH IS KEY TO PROVIDING EXTRA RELIABILITY.



Our wide range of flat tappets and rollers will get the most power and performance out of your camshaft.

TAKE IT TO THE NEXT LEVEL!



HYLIFT JOHNSON

Made in USA

HYLIFT-JOHNSON.COM • 800-441-1400

circle 40 for more information

climbing up the back of the engine when launching off the starting line. But it's also important to consider what happens after the car passes the finish line at the other end of the strip. A wet sump drag race oil pan will typically have a deeper sump and baffles to keep oil around the pickup. Some drag race pans relocate the pickup to the middle of the pan and place trap doors fore and aft of the pickup to control oil slosh during acceleration and deceleration.

With drag racing, high RPM oil flow is also critical. When a drag car flies through the traps at peak RPM, you don't want the oil system running out of oil flow or pressure. If the pump has already flatlined or is sucking air, it can be curtains for the engine. A wet sump oil system has to have enough capacity, flow and pressure to prevent this from happening. Installing an oil pressure accumulator can provide added protection against running out of oil pressure at a critical moment, and also provide start-up oil pressure when a cold engine is first fired up.

Marine

The marine environment can also be very depending on an engine's oiling system. Like drag racing, a marine engine goes from idle to full throttle, but stays there a much longer time (maybe hours and hours in a distance race). What's more, the boat is not running on a smooth surface but is pounding across the waves. All this vertical motion requires additional baffling and control inside the oil pan to keep the pickup submerged. A dry sump system will provide more reliable lubrication under these conditions.

Diesel

Last and certainly not least are diesel applications. Dynamic forces are seldom an issue here because diesel-powered trucks and tractors are used primarily for towing and pulling where acceleration rates are more moderate. The stock wet sump system is usually able to handle the engine's lubrication requirements

unless there are special needs. A highly modified diesel engine may require larger piston oilers and more oil flow for higher engine speeds, so a high volume pump may be a necessary upgrade.

One pump that often needs upgrading on diesel applications is

the High Pressure Oil Pump (HPOP). This pump has nothing to do with engine lubrication because it supplies the fuel injectors. A higher output HPOP is required if the stock injectors are replaced with larger capacity injectors. ■

SCHUMANN'S DYNAMIC PERFORMANCE™ Industry Engine Parts Supplier Since 1970!

www.SchumannsSalesAndService.com

- #1 **Manufacturer of Performance Oil Pumps for Most Engines.**
Over 150 Part #s!
- #1 **Engineering**
(Ultimate Series, Energy Recovery, 140% Volume By-Pass, and LS Extreme Series)
- 1 **Of A Kind Custom Projects Our Specialty!**
Land / Sea / Air!
- 1st **Dual Ball Valve External Modulation Volume of G.P.M. and High R.P.M. / P.S.I.**
- 1st **Development of "Gear Pressure Balance!"**
Mechanical and Hydraulic Design Balances Offset Gear Mass. Direct Injection of Fresh Oil Into Five Lobe Rotor Ring O.D. and Driven Shaft Bore.
- 1st **Internal "Dual Feed" Oil Supply to Top and Bottom of Gears.**
Eliminates Typical Aeration of Bottom Feed O.E.M. Style Designs
- 1st **Available of "Dual Feed" Technology in 1.500 x-volume, 1.200 Std. Volume and 1.000 Low Volume Gears.**

"Patents Issued / Pending / And Applied For" Ford - Mopar - Olds - Pontiac!!!!

All Ford 4 cyl / 6 cyl / V-8's with 4 Bolt Cover Cover Plate, Small Block Mopar, Big Block Olds and Pontiac Now Available in "Dual Ball Valve Technology!"

No More Obsolete O.E.M. Internal Volume Oil By-Pass!

Merger or Acquisition Opportunity Available!

Verne Schumann "Tribologist"
Engine Lubrication Engineer!
Senior Society of Manufacturing
Engineers Member!



P.O. Box 128 • Blue Grass, Iowa 52726
Phone: 563-381-2416 • Fax: 563-381-2409

circle 41 for more information