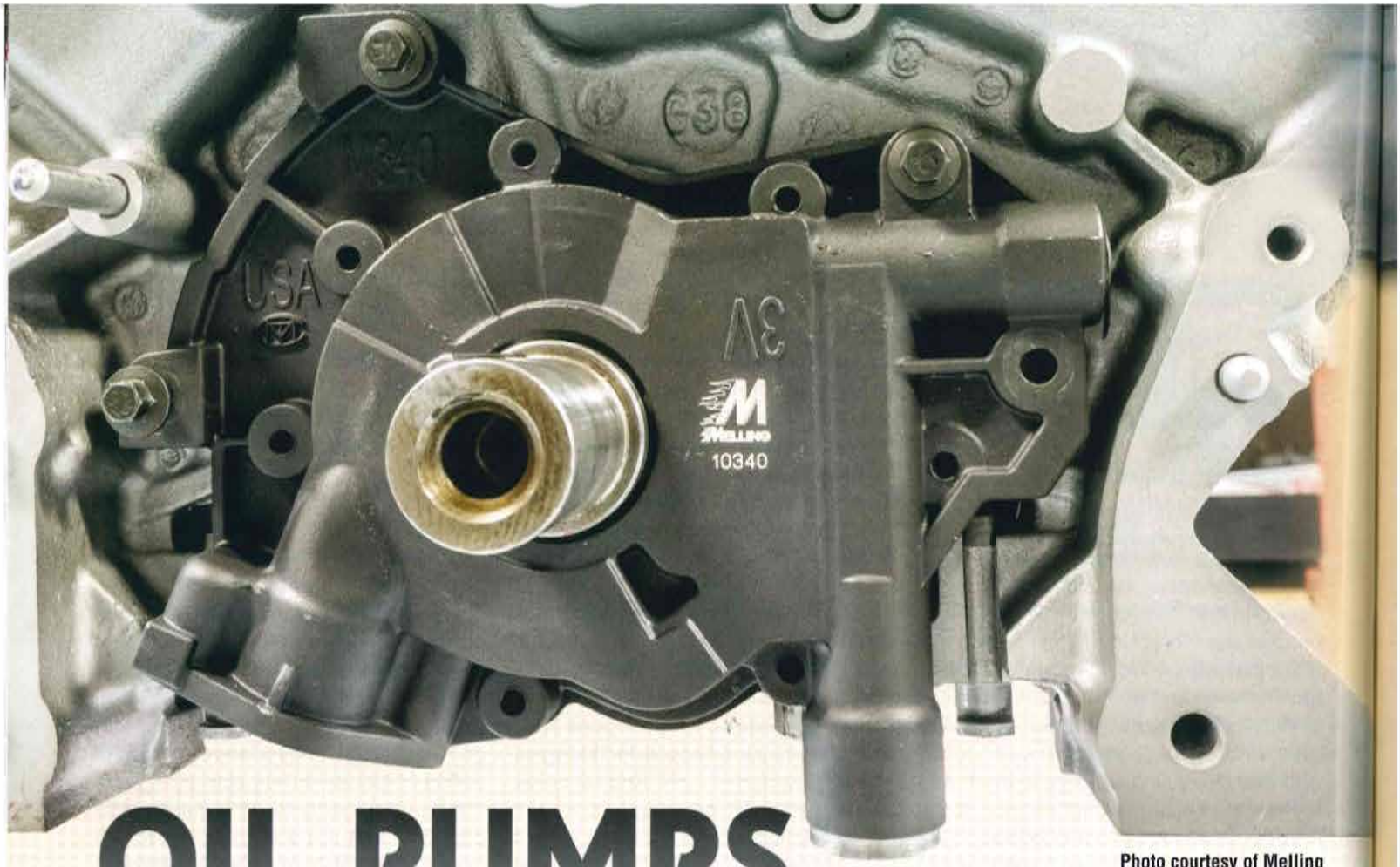

Photo courtesy of Melling

OIL PUMPS

Providing Pressure For Premium Performance

RACING OIL PUMPS differ widely according to the racer's purse and purpose. For some applications, a beefed-up version of the stock unit, suspended in a properly baffled oil pan, may prove more than adequate; for others, nothing less than a full custom creation packing six (or more) vacuum stages will do.

So we decided to approach the subject in stages as well. First, we'll look for classes and series where demand for professional-grade pumps is growing; that will provide an opportunity to discuss some new products as well. Next, we'll examine the craft of oil pump manufacturing: How do the top builders ensure the consistent high quality of both materials and assembly? Finally, we'll explore some of the most common tech support questions these manufacturers receive—and how they answer them.

Prime Movers

Beginning our look into some prime movers and promising markets, several manufacturers report growing demand in the drag race Hemi arena. "The strongest demand for our oil pumps comes from the drag race market," observed Mark Mittel of System 1 Filtration, Tulare California, "specifically for blown or turbocharged Chrysler Hemi and 481X-type motors. We offer wet-sump pumps in three different sizes, and dry-sump pumps in two, so we can fit any customer's particular needs."

Stefan Verdi of Auto Verdi in Söderbärke, Sweden, noted a "growing use of our dry-sump systems in Pro Mod and Alcohol Funny Cars. We have created a 90-degree drive that fits on the stock Hemi oil pump mount, so the pump lies alongside the block instead of sticking out. We actually released it a couple of years ago, but now it is suddenly taking off very well, and sales are growing very quickly." He believes that Fuel Funny Car teams may adopt the same pump as well.

Verdi reminded us that the NASCAR Xfinity Series now allows six-stage dry-sump pumps, "so all of the teams in that class are upgrading from their current five-stage pumps." And drifting "is very up-and-coming, not only in Europe but in the United States. The trend is toward more serious engines, and sales of dry-sump systems for this market is growing dramatically."

Other manufacturers reported different experiences. "We started making pumps for the Chrysler 426 Hemi in 1990," recalled Bob Sanders of Titan Speed Engineering, Ojai, California. "Now our strongest markets are drag racing and oval track, in about equal measure; although we also sell to tractor pullers, mud boggers, road racers and various marine customers. Oval track and road racing are growing the fastest." New from Titan Speed is a Pro Series dry-sump pump that mounts in the pan. Available in several sizes, "it is designed

Manufacturers share insights into the technology behind these vital engine components, their latest creations, and answers to commonly asked technical questions.

By John F. Katz

for any Chevy-type engine with room for a fairly deep oil pan, and can be used for pulling, monster trucks, mud bogs and many types of drag racing, including Fuel Altereds and Gassers." These pumps are shipped with driveshaft and mounting hardware, but fittings are sold separately.

"Right now," added Roy Johnson of Johnson's High-Tech Performance, Valencia, California, "the strongest demand for our pumps is in sprint cars, both bellhousing and block-mounted. But demand is growing fastest in overseas markets, where our pumps are appreciated for their durability and resistance to wear."

Tim Foster of Melling Performance in Jackson, Michigan, finds demand strongest "in both the grassroots and sportsman levels of circle track and drag racing." New from Melling are Shark Tooth oil pumps, whose gear teeth incorporate a "helical asymmetrical profile" for "a far more consistent and steady flow compared to a straight-cut spur gear. Pressure ripple, or pulse out of the pump, is reduced up to 70 percent, which in turn helps reduce both spark scatter and wear on the pump drive system." These pumps are available for traditional Chevrolet small blocks in stock volume, +10 percent, or +25 percent configurations.

Melling's fastest growing line, however, are the pumps they manufacture for GM LS engines. "We still sell more pumps for traditional small blocks, by far," Foster clarified, "but the LS segment keeps growing at a rapid pace, year after year." Part numbers 10295 and 10296 fit both Gen III and standard Gen IV variations, providing stock and +18 percent volume, respectively; while part number 10355 provides the 33 percent increase in volume required by a Gen IV equipped with Active Fuel Management and/or Variable Valve Timing. These pumps come with a high-pressure relief spring installed, and a stock-pressure spring packed in the box.

Also primarily for LS engines, ARE Dry Sump Systems of Loomis, California, is now producing "an all-new and very unique dry-sump belt guard," said Gary Armstrong. "We sell quite a few dry-sump systems for Ultra 4 and off-road racers, and they are always concerned about rocks and debris knocking the belt off the pump—and rightfully so. Our belt guard's

Photo courtesy of Peterson Fluid Systems

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A356 T6 aerospace alloy casting is fully CNC machined. It mounts securely to the crank and to our pump shaft, supported on ball bearings." And although designed for the LS, this new belt guard fits all ARE direct-to-block dry-sump systems.

John Schwarz of Aviaid Competition Oil Systems in Chatsworth, California, confirmed that "anything with an LS in it" represents a growing market—particularly LS-powered road racing and drifting. In the latter, particularly, "you run what you brung, and you run for 30, 40, or 50 seconds. And now they are learning that you can ruin an engine in 30–50 seconds. That's why we're seeing a lot of growth."

Utilizing premium materials for oil pumps not only helps fight premature engine wear, it can also directly improve performance. Plus, selecting the correct material can prevent flexing and leaking at high rpm, ensuring the engine receives sufficient oil. Photo courtesy of System 1.

Additionally, Schwarz said, "We've supplied oil systems for diesel pulling tractors for a long time, but now more trucks are used in pulling. And when they pull off the starting line, they rise up on their rear wheels, and they saw up and down. They don't run at nearly the speed of a drag racer, but they still move in a way that causes the oil to slosh. And if you have 13 or 14 gallons of oil under the engine, you better have a handle on it. That's why we're seeing trucks with five- or six-stage dry-sump systems. We build them with integrated oiling to the turbocharger and a fuel transfer pump."

Moroso Performance Products in Guilford, Connecticut, is actively involved in the Street Outlaw market, "and we

know how hard those cars get pushed," observed Thor Schroeder. "Our newest and most versatile dry-sump pumps are our Tri-Lobe line. We debuted them in our 2012 catalog, and we've added variations every year since. For 2017, we are offering the single-, three-, four-, five- and six-stage pumps with an optional rear-mounted 3/8-inch hex fuel-pump drive with a 1:1 ratio, to accept the popular 1.450 ID, three-bolt fuel-pump swivel clamps. We're also offering a two-stage pump—a first for Moroso—with a fuel pump drive standard, based on customer demand.

"These are not only the highest-performing dry-sump pumps we have ever produced," Schroeder continued, "they are also the most versatile." Available brackets can fit either side of a door car, or the left side of a dragster. Additionally, three pressure sections are available: a standard .900 inch; a 1.200 inch for 60 to 120 psi; and a 1.800-inch unit for 130 to 150 psi. This last pressure section, Schroeder added, is "for high-boost, big-displacement turbo cars."

The fastest growing segments for Boundary Oil Pumps of Houston, Texas, are the four-cylinder and V6 engines, according to Travis Rosenbarger. "While domestic power is still the largest market share in the US, these small markets are often deprived of lubrication solutions," he said. "Our ability to create new gerotor profiles and ship to customers in as little as a single week is an advantage. With vendors working with us to quickly verify product, we pride ourselves in our ability to come up with solutions quickly. We've launched two new products in these markets, which are oil pump gears for the SRT4 and the Nissan 370Z."

Pump Tech

If it all seems a bit complex and specialized, well, that's because lubrication, in Schroeder's words, "is not an area where you want to scrimp. Our Tri-Lobe dry-sump pumps are machined from aircraft-grade aluminum billet." Assembly begins with checking the individual parts against blueprint specification. "This is actually the third time that these parts are checked against the print. The first

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is during our in-house manufacturing process, the second when our Quality Control Department examines each part before it goes into bulk inventory. During the third inspection, just before assembly, all edges are checked and filed if necessary by someone who has at least 15 years of experience assembling our pumps. Filed parts are then ultrasonically cleaned before assembly. Then, during assembly, our technicians check rotor-to-housing clearances, O-ring retention, and end play. Finally, our Tri-Lobe pumps are run on a test stand to make sure that pressure and vacuum performance are where we expect them to be."

Sanders also emphasized the importance of quality control, of building all pumps in-house and only with top-grade materials. "We machine and check every part, and assembled pumps are extensively tested for flow rate and pressure. Our gerotor sets are billet steel, not powdered metal. For other parts we use only aircraft grade 7000 series aluminum, which is Mil-Spec hard-anodized. We use only premium, US-made fasteners from ARP and Holo-Krome. Our motto has always been that anything less than the best can and often does lead to parts failure."

Johnson uses "strictly Mil-Spec-certified materials matched to eliminate distortion from heat and pressure. With lesser materials," he said, "we could not hold the same tight clearances; we'd lose efficiency and possibly cavitate the oil. And as a certified aircraft manufacturer, we maintain Mil-Spec tolerances, with 100 percent of our parts measured to within .0001 inch on a coordinate measuring machine."

Verdi also buys "our aluminum and steel only from very, very high-end suppliers, and we've never had a failure due to material. All parts are checked before assembly, and we test every pump before it is shipped out."

And Foster agreed that, "premium materials are paramount to the success of Melling's performance pumps. Our aluminum housings, whether billet or die-cast, are hard-coat anodized to prevent them from being worn by the steel valve and gear sets working inside of them. The cast

iron covers on our over-the-crank pumps are stiffer than the typical stamped steel or die-cast aluminum pieces. And, we add a phosphate coating to increase lubricity between the cover and the gears. In our spur-gear pumps, we use billet steel for the gears and chromoly for the driveshaft. We also use chromoly for our performance pumps with billet gerotors."

Beside fighting premature wear, premium materials can also directly improve performance. "At high rpm, an aluminum cover will flex and leak," Foster continued, "while a cast iron cover remains rigid and leaks only minimally. And the amount of oil that leaks through the cover is the amount of oil that the engine does not receive." For every pump they make, from OE-replacement to high-performance, Melling "requires measurements on a specific schedule during production. And we performance test 100 percent of our pumps after assembly, ensuring that the pump primes properly and reaches the correct flows and pressures at idle and bypass rpm's."

When racers have tech or installation questions, they often turn to engine builders and retailers, who themselves can serve as valuable sources of information by educating themselves on products and processes, like how to plumb a dry-sump system, or how to adjust the oil pressure, explained one of our sources.

With any racing oil pump, contamination is a potential issue. "We know that, ultimately, you're going to get debris in the oil," said Schwarz, "and the gears will absorb it to some degree, but they will also deform to some degree and pass some of it through. So one of our critical design criteria is what we call survival mode: If we can keep the pump turning, even if it's grinding itself to death, until the

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TIME TO GET WET?

Given the extreme performance of today's racing vehicles, John Schwarz of Aviaid in Chatsworth, California, questioned whether if, in "any form of motorsport, once you reach the top levels, you can derive adequate lubrication from a wet-sump system. The violence of the forces in a modern racing vehicle has gotten crazy. And then compare the cost of a dry-sump system to the cost of building a competitive engine. And by competitive, I don't mean front-running, I mean an engine that can keep up in the middle of the pack. Do you really want to rely on a $250 oil pan to protect a $25,000 engine?"

While many sanctions mandate a wet sump, their members manage to run and survive, he said. However, those racers rebuild their engines and suffer higher failure rates than they should, all with the intent of affordability. Schwarz believes that the cost of a dry-sump oiling system is misunderstood. "By the time you buy a custom-fabricated wet-sump pan with an Accusump and other accessories, you've spent half the price of a dry-sump system. We build basic dry-sump systems for small block Chevrolets for $2200–$2300. You couldn't buy a set of bearings and rings for that, much less all the other costs involved in rebuilding a motor."

Schwarz also cited the advantages of using cast iron housings for pressure sections. Aluminum is "easy to machine and relatively inexpensive. But today we have zero-weight and negative-weight oils," he said. And as the pump heats up, "an aluminum housing is going to expand at about twice the rate of steel gears. That's why we offer cast iron versions of all of our pressure sections—so you can run a low-weight oil without nearly as much slippage across the temperature range." —*John F. Katz*

knucklehead in the seat figures out there's something wrong and shuts it down, then there's half a shot at saving the engine before it welds itself into a pile of slag." For that reason, Aviaid's pressure sections use gears made from "a dead-soft, high-lead-content steel. It's also why we screen all the pickups in the pans we build, to keep out chunks that would be large enough to stop the oil pump. You can only deform a gear so much before it says, 'Ah, to heck with you,' and then strips the belt while the engine's still turning 8000 rpm."

Dailey Engineering of Temecula, California, uses "only Roots-style rotors for the scavenge sections, and spur gears for the pressure sections," Bill Dailey noted. "The materials we use are aircraft-grade aluminum and steel. And we pay very close attention to the manufacturing tolerances and details." Dailey pumps have supplied oil to championship-winners in NASCAR, IMSA/sports car, Pro Mod and Pro Stock motorcycle drag racing, as well as Australian Supercars, among others. Dailey added how the ability to share digital solid modeling files facilitates cooperation with chassis builders.

In addition to these custom-made units, Dailey also offers a shelf-stock line of "Classic" oil pumps, which cover most of the popular configurations. "But they are made to the same tolerances, and are manufactured with the same practices, as our full-custom pumps," said Dailey.

Boundary Oil Pumps is heavily involved with the billet oil pump gear market and high-flow blueprinted oil pump assemblies, according to Rosenbarger, who claimed that the most unique benefits to the company's product comes from the specialized gerotor profiles that are engineered using proprietary software. Instead of copying stock gears, "we've designed software that can optimize profiles for strength or flow," he said. "In addition, our high-flow oil pump assemblies take this a step further and open up the housing and gerotor to modification. We use cast housings that are milled, and take advantage of both our proprietary software and our ability to fit larger gears in the housings with custom machining. The high-flow assemblies

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provide additional low-end oil pressure and maximum overall oil pressure, which is very important to some of our customers who push the envelope in power."

Pump FAQs

Which brings us to our final section: What are the most common questions that racers and engine builders ask about oil pumps?

"How much oil do I need?" replied Mittel. "In a quarter-mile drag race with a blown Hemi motor, it is possible for six or seven quarts to be trapped upstairs in the heads and the valley; and this oil can't return to the pan until the motor starts spooling down after the run. Obviously, it is very important to carry enough oil to reach the finish line without running out, or sucking an air-oil mixture." To avoid this potentially destructive situation, a System 1 dry-sump setup should carry four to five gallons of oil, while a wet-sump system, "in most cases" needs four to four-and-a-half gallons. "Carrying a little extra oil," Mittel added, "is better than making junk out of parts that could have been lubricated."

Assembly of oil pumps often begins with manufacturers checking individual parts against a blueprint. Next, parts are ultrasonically cleaned. Then, during assembly, technicians can check specifications such as rotor-to-housing clearances and more. Finally, oil pumps are typically tested before leaving the premises. Photo courtesy of Auto Verdi.

Schroeder, also, has been contacted by drag racers who found their engines losing pressure at the end of a run. "A few things can cause this," he noted. "A pan with insufficient baffling will let the oil get away from the pickup during deceleration. This can definitely cause a pressure drop. But another cause may be cylinder heads

that accumulate oil rather than allowing it to drain back to the pan. Add a high-volume oil pump, and you can pump all of the oil into the heads. And a vacuum pump can make the situation even worse." Potential fixes include adding extra oil to the pan, switching to a pan with better oil control, and running external drains back to the pan. "Another option is running an oil accumulator," Schroeder suggested, "to store extra oil and dispense it to the engine whenever the pressure drops."

Customers also ask Moroso if they should run a high-volume pump. "We suggest they discuss that with their engine builder," Schroeder continued—unless they are running a Dart block with priority main oiling. Then Schroeder points out that Dart itself recommends a high-volume oil pump. "And then a lot of customers ask us, 'If I'm running a high-volume oil pump, should I add an extra quart of oil?' We always recommend they do. A high volume pump moves oil pretty quickly, and that, especially when coupled with insufficient drain-back, can cause issues."

Still other customers ask if they should weld the pickup to the pump—even if it came with a bolt-on support bracket. Schroeder answered yes, they should, to "minimize any chance of a pickup coming loose or breaking—and because welding helps make a more uniform seal."

Included in the purchase of every Johnson's High Tech Performance oil pump is "an outline explaining how to calibrate the oil system to the engine's requirements," said Johnson, "as well as a list of system requirements, i.e. hoses, fittings, reservoir, baffled breather canister, filters, and internal support coils for suction hoses."

Dailey, meanwhile, reminded us to use plumbing that's sized appropriately for the pump. "We've found that no matter how large the gear section is, the limiting factor is the size of the line feeding the oil pump from the tank. We're now building pumps with –20 inlets and –16 outlets for the pressure section. This is very important to avoid cavitation in the inlet. A –16 feed line limits a pump to about 18–20 gpm, no matter how large the pumping section is." PRI