



OPENING THE WINDOW ON VALVES, SEATS & GUIDES

IN THE open-and-shut world of racing engine valves, 2016 promises to be a year of growing sales and technical refinement. Growth, as innovations of the past several years reach an ever-wider audience, and refinement, as manufacturers hone those same innovations to perfection.

"For several years now," reported Ken Sink of Milodon, Simi Valley, California, "we've seen a steady increase in demand for high-quality, high-performance valves. Engine builders are guiding customers toward higher-quality, one-piece valves—which help eliminate returns and failures."

Durability is, of course, a virtue in any component, and especially in one facing such high mechanical and thermal stresses. But the main job of a valve is to let air in and exhaust out of a cylinder. "We continue to work on the leading edges of airflow and surface finish on the seat area of the valve," noted Melissa Blackwell of CV Products' Xcelodyne division, Thomasville, North Carolina. "Technological advances in equipment and tooling have brought new machining techniques to this area of the valve, for improved performance and longer life."

And since lighter valves translate into less stress on the whole system, Blackwell added, "mass reduction techniques also continue to advance—areas such as hollow heads and hollow stems. We are currently deploying several options for hollow-stem valves, offering engine builders engineered solutions depending on their requirements."

According to Will Kibblewhite of Kibblewhite Precision Machining in Pacifica, California, the biggest changes in valve manufacturing do not involve new technology on the racing side so much as widespread acceptance of established race technology

by the OEMs. "Hollow stems have been around for a few years, as have various PVD coatings, as well as high-temperature super-alloys and various titanium alloys," he said. "The biggest change has been how all of these developments have affected the OEMs."

The Long & Short of It

All of which hardly means that race valve manufacturers can comfortably rest on their seat inserts. Sink noted how "many new cylinder heads are now available, and the majority need longer valves than prior models did." So Milodon has increased the number of Megallow valve applications that range from .100- to .280-inch longer than stock. "Our Megallow valve line can handle operating temperatures of 1600 degrees F," Sink

continued. "Manufactured from 21-4n, they come with Stellite tips hardened to 58-60 Rc, and are swirl-polished with undercut stems for lighter weight with greater flow." That light weight not only allows quicker acceleration, but also enhances valve spring life. Milodon's Megallow valves are used in "circle track, drag racing, offshore marine, and street performance—and they are great for supercharged applications."

A growing demand for custom-sized valves was cited by Ian A. Levitt of QualCast, Nashville, Tennessee, "including longer stems, and oversized heads, for less restrictive forms of racing."

CV/Xcelodyne, said Blackwell, has "developed proprietary software for custom valve manufacturing, allowing

real-time print generation of the valve. This gives the customer the ability to check geometry, mass calculations, dish volume (if applicable) and other features, thus reducing production time from start to finish. We understand the engine builders' need to turn builds around faster to improve revenue generation, cash flow, and, most importantly, customer service."

"We're receiving more custom valve orders for a variety of reasons," added Willy Tagliavini of Supertech Performance, San Jose, California. "Some look to increase performance and flow rates through special back angles and seat angles. Others need new valves for the new-for-2016 regulations in several series, which regulate the dimensions of the head and stem diameters. Still

Trends in today's valves market include the use of titanium versus steel, longer valve lengths, and the development of custom valves, among others. That said, racers almost invariably demand high-quality, high-performance valves that can eliminate returns and, most importantly, failures. Photo courtesy of Engine Pro.

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others need to cope with the extreme heat generated by turbocharging, so new designs are in order, and we offer a wide range of options, including special shapes, special materials, and sodium-filled valves."

"Because we have a dedicated custom valve department," said Kibblewhite, "and we are able to respond quickly to small-volume custom requests, we have always produced a large quantity of custom valves, which are used in everything from vintage Grand Prix engines to prototype heads. Often a customer wishes to try a different tulip shape and/or for a different radius leading to the tulip. We get a lot of requests for oversize heads, different face angles, and in some cases, a customer is reducing the stem diameter to lighten the valvetrain. That can lead to developing an entire small stem system. We can produce a few pieces for testing in our custom shop, and once the customer tests and confirms results we can produce a forging run."

Turning to Titanium

Titanium has become the gold standard—if you'll forgive the mixed metaphor—in lightweight engine valves. Tagliavini reported "an increasing demand for titanium valves in the sport compact scene, especially for drag racing, due to the use of more aggressive cams, and need to control the valvetrain."

Not surprisingly, Kibblewhite agreed. "We are seeing a lot of turbos and nitrous systems being added to small-displacement, high-rpm, four-valve engines. This has increased the demand for small-stem Inconel exhaust valves, and for titanium intake valves. To that end we've increased our production of our one-piece forged Tensile titanium valves, and also our White Diamond Inconel valves, to meet this demand."

"We have also put our engineers to work on creating a titanium valve that is superior to what the OEMs are offering," he continued. "Fortunately, we have the design software with FEA analysis to make this happen. And because we have the ability to design a better valve, we've increased our production of our

one-piece-forged, CrN-coated Tensile titanium valves. The CrN coating offers superior resistance to impact, abrasion and corrosion; and when combined with our surface-finishing process, it provides a very smooth stem with a low coefficient of friction."

The main advantage of a one-piece forging, Kibblewhite explained, is "uninterrupted linear grain flow, which means excellent tensile strength. It also means uniform response to heat-treatment, and stability at operating temperature. There is no heat-affected weld area to interrupt the grain flow, or react differently to heat-treat or operating temperatures and stresses. The end result is a strong, light, stable valve that resists face recession and corrosion—and is easy on the valve guide."

Xcelidyne, said Blackwell, has "CrN-coated valve applications in stock for sprint car, dirt late model, and 18-degree cylinder head applications. We have also introduced a new CrN coating called CRT especially for sprint cars, where the combination of alcohol fuel and dirt can accelerate wear in the seat area. The extra micron layers of the coating help extend the life of the valve, especially in this demanding environment. And shelf-stock capability reduces lead times for the engine builder. That's a real bonus!"

In addition to offering valves in stainless steel, Ferrea of Fort Lauderdale, Florida, also manufactures titanium valves. Each Ferrea titanium valve is meticulously machined in the company's precision CNC machining centers, where it must pass extensive quality control procedures, noted company representatives.

Also available on Ferrea's valves is its proprietary Chrome Nitride (CrN) coating, which is applied uniformly to the entire valve, forming a protective insulating barrier from high engine temperatures. Ferrea's CrN coating is engineered to provide rapid heat dissipation to the valve guide surface, friction reduction, wear resistance, hardness, and allow dynamic valvetrain forces and valve flex stresses without delaminating or flaking.

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of manufacturing titanium valves, X-Ti LLC of Moscow, Russia, maintains its production process in-house, including blank preparation, forging and machining divisions, a shop for thermal treatment and applying wear-proof coatings, as



As with the valves themselves, some of the leading advances in seats and guides involve material science. In fact, manufacturers of these components work closely with suppliers to develop new alloys and material combinations to counter the high heat and high load found inside race engines. Photo courtesy of Dura-Bond.

well as a metrological support division. According to Vitaly Borbashov, X-Ti continually works on developing new coatings for its products, and currently offers PVD and CVD coatings, as well as a traditional CrN coating.

In addition to valves in both off-the-shelf and custom offerings, X-Ti also manufactures valve seat inserts, valve guides and spring retainers.

Valve Valves

Don Weber of Engine Pro in Wheat Ridge, Colorado, pointed to other growth opportunities. "The expansion of the diesel performance market really stands out, and we will introduce performance valves for several applications really soon," he said. "And the Chevrolet

LS market also continues to grow." Engine Pro has recently added 39 new performance numbers, expanding their range of LS valves but also adding new coverage for 4.6- to 5.4-liter modular Fords, the Ford FE, Ford 429/460, big block Chrysler and Pontiac V8s. Custom valves are also available. In 21-4N, 21-2N, ad 21-4N Nitro Black. Both engine builders and end-users continue to require value and quality. Most people just don't have the money to spend on a high-dollar engine, so they are looking for the performance and reliability they need at an affordable price."

Weber also reported growing demand for Engine Pro's premium Nitro Black valves, which "offer the performance features of an exotic alloy at an affordable price." Faithful PRI readers are by now familiar with the process. Nitro Black is a form of nitriding, and like all nitride processes, it is not a coating but an actual metallurgical change in the surface of the part. "But while some of our competitors offer a surface treatment that only penetrates a few thousandths into the outer surface of the valve," Weber explained, "and others only nitride part of the valve stem, our Nitro Black process is a proprietary, five-step liquid treatment that introduces more nitrogen into the metal surface. The result is a stronger, more ductile valve—the entire valve, not just the stem. And our Nitro Black valve stems are smoother than chrome-plated stems, and can run with less lubrication."

Most importantly, the increased ductility of a Nitro Black valve can save an engine. "We like to say that 'bent is beautiful,'" Weber continued. "When our Nitro Black valves have contacted pistons during a race, they have bent rather than broken, averting a catastrophic engine failure. For the racer, that's the difference between a tough day and a disaster."

"The continuing quest for less weight, less friction, less heat and greater strength continues unabated," QuaCast's Levitt observed. "In pursuit of those ideals we have introduced our Black Lightning range of one-piece, 21-4N performance valves. Instead of chrome-plating the

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AS with the valves themselves, some of the most significant advances in seats and guides have come in the area of material science. "We are currently working with our suppliers to develop new alloys and material combinations to combat the high-heat and high-load problems that our customers have been struggling with," said Ed Doyle of CHE Precision, Newbury Park, California. "Our relatively new B7 material continues to work extremely well in Top Fuel, blown alcohol, and Pro Stock applications; while we are still working on a seat that will survive in high heat and lean fuel mixtures used in NASCAR. With the coming of unleaded gas and fuel injection, seat problems on the exhaust side of the engine have become a major headache for some of the NASCAR teams."

"Key developments would include the use of new materials, such as Moldstar 90 and Moldstar 22 for valve guides and seats," reported Debbie A. Jackson of Precision Products Performance Center in Arden, North Carolina. "Changes in fuel have required people to upgrade to a better alloy for longevity. Moldstar offers increased lubricity as well as stability regarding wear. And even though these new materials cost more, these costs are offset by long-term longevity, with less maintenance and less frequent valve seat replacements during the life of the head or the race season."

Jackson also noted how "internal O-ring grooves on valve guides are becoming more commonplace, because of higher lifts resulting in not enough clearance between the retainer and a standard seat configuration."

Custom orders are dominating seat

and guide manufacture as well. "The demand for custom components has significantly increased for all different venues of racing, for both seats and guides," Jackson continued. "This is because more people are rebuilding heads rather than replacing them"—as custom seats and guides cost considerably less than a new set of cylinder heads.

"Custom guides and seats are becoming the norm," agreed Claude Holguin of CHE Precision Products. "Knowing exactly what the customer is doing mandates what materials we recommend for their guide and seat applications."

Meanwhile, Dura-Bond Bearing of Carson City, Nevada, continues to produce and promote its Killer Bee copper-infiltrated, powder-metal valve seats. "Killer Bee valve seats are still our newest product," said Chuck Barnett. "Key customers such as Dart have used our Killer Bee valve seats to help keep their LS engine heads ahead of the curve. They use them in both the intake and the exhaust." In fact, Dura-Bond has released a number of new valve seats for the LS series, "as well as cam bearings and other hardware unique to the LS."

Valve seat and guide manufacturers often field questions about material. At CHE, according to Holguin, the most common questions received concern whether the "material selection will work in the customer's application. The next most frequent questions involve valve angles."

Jackson commented that the most common questions she receives from customers involve clearance—which, of course "depend on the alloy of the guide and material of the valve itself." —John F. Katz

stems, we nitride the stems and the top of the valve, while the under-head remains swirl-polished. The black nitriding finish is achieved by a plasma application process, which also adds nitrogen to the steel, improving resistance to corrosion and wear. The plasma nitriding process allows high-temperature metallurgical reactions to occur at low work surface



Technological advances in equipment and tooling are helping manufacturers introduce new machining techniques for use on the seat area of the valve, explained one of our sources, which in turn improves performance and extends part life. "We continue to work on the leading edges of airflow and surface finish [for this area]," she added. Photo courtesy of Xcelidyne.

temperatures, so it diffuses nitrogen into the surface of the valve without affecting the original core properties of the stainless material."

Blackwell reported an expansion of Xcelidyne's X2 range, which "now covers over 60 valve applications, including the Ford 347 SR, along with many GM LS numbers, and we are adding more at an accelerated rate. Our newest X2 range features a higher nickel content on all exhaust valves, for today's higher exhaust temperatures. And we're working on many Inconel applications for extreme EGTs. All of our X2 valves are designed for superior performance and excellent value, emphasizing three core criteria—the finest materials, the tightest tolerances, and the best finishes." —PFI

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