PISTON POWER

Text by Steve Dulcich
Photography by Steve Dulcich
and courtesy of JE/SRP Pistons

Progress is an evolution, with professional racing at the leading edge and the general high-performance aftermarket reaping the rewards. It seems as though development is not a steady continuum, but rather technology takes a big jump with the introduction of an innovative product line that sets a new standard. Just this type of leap in technology has been brewing at JE, where the Pro-Series SRP piston line is taking shape. Manufactured in the U.S. at the advanced JE/SRP Pistons manufacturing center in Huntington Beach, California, SRP pistons have always been a product designed to provide engine builders with value, quality, and features in a moderately priced, off-the-shelf piston. The newly designed Pro-Series goes several steps further, incorporating technology that, until now, has been exclusively in the realm of high-end custom racing pistons.

So, what is it that separates the new SRP Pistons from the pack? JE has long been a leading manufacturer of pistons for professional racing in venues such as

NASCAR's NEXTEL Cup racing, where piston design must be at the very cutting edge of available technology. The newly released SRP Pro-Series small-block Chevy and Ford pistons include features used in today's NASCAR NEXTEL Cup engines, such as lightweight forged side relief (FSR) forgings; short high-quality wristpins; precision CNC-machined ring grooves; and high-performance, narrow-section piston rings. It's worth taking a closer look at these design elements and how they can improve the power output of your next engine project.

A Better Piston

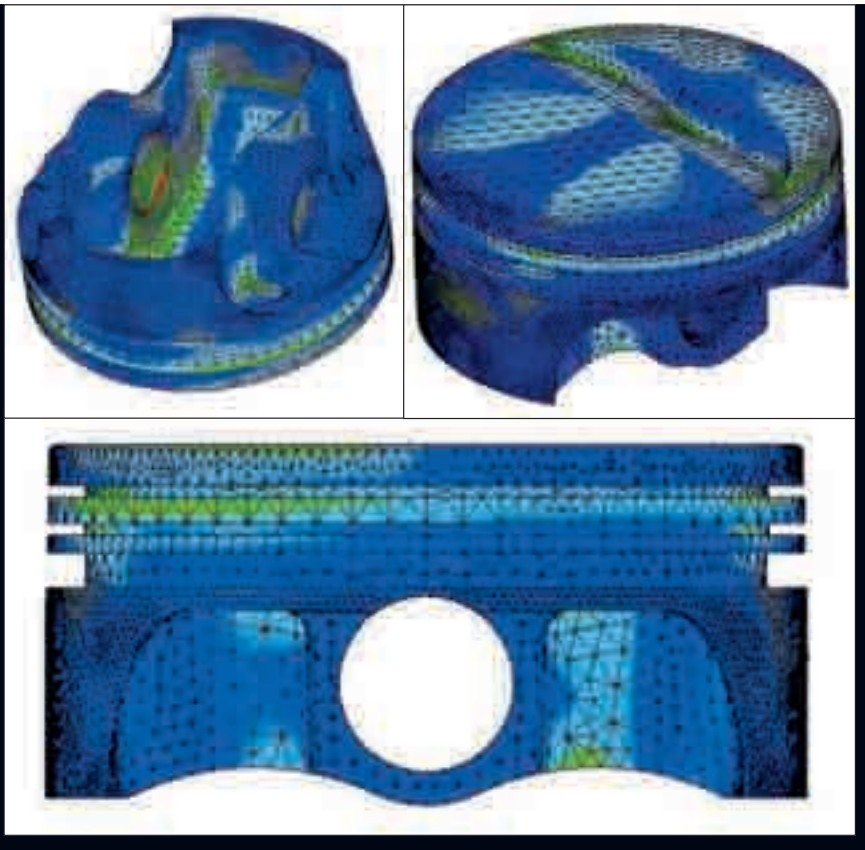
A piston's essential configuration is set in the forging's design, so a radical departure in the final piston requires

JE's New SRP Pro-Series Pistons Define a Modern Breed of Aggressive Shelf Pistons

JE/SRP Pistons Design Engineer Moises Romo is one of the many talented employees who had a hand at developing the innovative SRP Pro-Series pistons. His experience with NASCAR piston development enhanced the Pro-Series development effort.

considerable investment in new tooling to create the appropriate forging blank. One of the key elements in the new Pro-Series pistons is an all-new forging designed with the characteristic narrow skirt and pin boss of a forged side relief piston. This tooling is more complex and involved than a conventional forging, but with this configuration the manufacturer can produce a piston with reduced weight and friction compared to the conventional design. Using Finite Element Analysis modeling, the Pro-Series forgings were rigorously examined for an optimized balance of strength and weight

The advanced JE/SRP Pistons manufacturing center houses state-of-the-art equipment to handle all aspects of the design, manufacture, and inspection of some of the world's best pistons. As the machinery visible in this corner of the main machining floor shows, manufacturing to this standard takes no small investment in equipment.



Development of the new Pro-Series SRP piston line took place over the course of an entire year. The piston designs were created using 3D computer modeling and tested for strength using Finite Element Analysis (FEA). Computer modeling using FEA technology gives a very clear indication of the stresses and forces acting on the piston under various load conditions. Continual revisions were made in the design process to optimize strength and weight before manufacturing began.

reduction.

While the forging's design will set the foundation for the resulting pistons, choices in material and machining will also have a major effect upon the finished product. Pistons can be forged from a variety of aluminum alloys, with 4032 and 2618 being the most popular. For the SRP piston line, the higher-silicone 4032 alloy was the choice because of the material's lower coefficient of thermal expansion, tighter cold-running clearances, and greater hardness and wear resistance. This is the ideal material for durability in a variety of appli-

As a part of its rigorous development process, JE/SRP Pistons manufacture billet pistons from solid pucks of aluminum for dyno-testing in actual engines prior to approving the final forging designs. Testing in this way gives it an opportunity to make small adjustments to the design, improving performance and strength before adding to the product line. Actual testing allows JE/SRP to validate and verify its products' performance.

cations, from street to Sportsman racing categories. Further design improvements include a short 2.250-inch wrist pin retained by wire locks, which results in lighter weight and a stiffer pin than the traditional setup.

Perhaps the most aggressive aspect of these new pistons is the piston ring configuration. In racing, the undeniable trend has been toward narrower ring sections utilizing stronger ring materials for a package that is lower in drag, lighter, and more reactive to distortions in the bore. The result is more power from reduced drag, better performance at high rpm, and potentially better-sealing. For the Pro-Series SRP pistons, the ultra-flat ring grooves are precision-cut to accept 1.2mm gas-nitrided steel top rings, 1.5mm napier (relieved, hook-faced scraper) second rings, and 3mm oil control rings. This is quite a departure from the old 5/64-inch production ring packages, and much more aggressive than the industry-standard 1/16-, 1/16-, 3/16-inch combination found in most traditional performance applications. The required

The result of JE/SRP's development effort is an advanced piston with features mirroring a professional racing product at a price the Sportsman, racing- or street-performance enthusiast can appreciate. Here is a production-line example of the new Pro-Series piston.

The new skirt configuration takes a much shorter piston pin than a conventional street piston. The shorter piston pin offers the dual benefits of greater stiffness and lighter weight.

A peek under the skirt of the new Pro-Series SRP piston next to a conventional forging (right) shows the dramatic difference in design. The new piston takes its cues from JE's racing piston development.

A very aggressive ring package is also part of the Pro-Series theme. The 1.2-1.5-3mm ring package is low on drag and high on conformability and is at home at high rpm. Note the comparison to the conventional 1/16-1/16-3/16 rings on the piston to the right.

rings are supplied in a package with the new SRP pistons, ensuring the engine builder has a combination designed to work together.

When you combine the outstanding engineering and design features employed in these new pistons with JE/SRP's enviable reputation for quality, the net result is extremely attractive. What's better is that these pistons are part of JE's SRP line of readily available part numbers, at a "value for the dollar" price, with rings, pins, and locks included. The upshot is that those of us who have been priced out of the market for features that were previously found only in custom high-end racing pistons can now take advantage of this race-winning technology in any high-performance build, even in moderate nitrous and forced-induction applications. More piston for the money is a formula that is hard to beat.EM

At the JE/SRP facility you will find an inspection and quality control lab that is second to none. There are numerous machines that will take highly precise quantitative measurements to ensure the pistons are right on spec.

In addition to quantitative inspection, detailed qualitative inspections are also part of the program. Here, a piston is being visually inspected under high magnification for signs of machining distress and other flaws.

FROM RAW FORGING TO FINISHED PISTON

Manufacturing a piston involves numerous machining steps, starting with a raw forging as the basis. Much of the piston's design is set by the forging itself, which in turn is set by the forging die's design. The forging process transforms a chunk of aluminum into a net shape roughly approximating a piston, while the subsequent machining operations transform it into a useable piston. A raw forging can serve as the basis for quite a range of different piston configurations, depending upon the machining specifics. Here we show the sequence of operations that together produce the finished piston.

Here is an example of a typical piston forging. Most of the key parameters, such as valve relief size, placement, and depth; compression height; dome or dish configuration; pin diameter, length, and retention; and ring groove specifications can be varied within a range to produce quite a remarkable assortment of possible pistons.

Piston-lathe operations produce the piston's basic form, the ring, attenuator, and reservoir grooves. The lathe operations are the initial step in converting a raw forging into a useable piston.

Machining the pin bore, draining oil in the ring groove, and getting the pin oilers comes next. The pin bore's position is a major aspect in matching a piston to a specific compression height and engine application.

Another machining operation cuts the piston's side reliefs. This is a piston forging designed with a conventional-style skirt in mind. The new Pro-Series skirt requires a special forging and results in a different skirt configuration.

There are many other detail machining operations that may be required, depending upon the needs and specifications of the application or of the engine builder in a custom application. Here, the piston has been machined for pin retention, and lateral gas ports have been added.

The dome profile can be as simple as a flat-top or as narrowly focused as a specific profile designed for a cylinder head's combustion chamber. Note the substantial material removal from the previous step.

Valve reliefs are cut depending on the requirements of the application or the specifications of the builder in a custom piston order. Pocket depth, radius, and placement are the key specifications here.

Next, the lower profile is cut away to the final shape, and the basic piston is completed. Several more machining operations can be specified depending on requirements. Deburring and cleaning finish the pistons, and then the set is boxed and ready to ship.

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