

# PISTON

## PROPAGATION

A look at the evolution of modern piston design with Ross Racing Pistons



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PHOTOS COURTESY OF THE MANUFACTURERS

It's almost cliché these days to talk about how quickly technology advances, as that is an obvious fact of life all around us, from cell phones and personal computers that are obsolete as soon as you open the box, to factory grocery-getters producing power numbers that would make a muscle car of yesteryear drool in envy and a feature list that used to be reserved for cars coming from dealerships that required a credit check just to walk in the door. Obviously, if you're reading this magazine, you know how our sport has, and continues to grow by leaps and bounds every season. Often, that is attributed to the technological advances—engine control, power-adder control, power adders themselves, and advanced software. However, we had a discussion with the folks over at Ross Racing Pistons, and delved a little deeper into the creation of power, focusing on one of the most important parts of the equation: the component that not only takes brunt of stress of the combustion, but dictates so many of the key specifications of an engine—the pistons. Ross Racing Pistons has been around since before a solid share of our readership—including your author—was born. Starting out in 1979, two partners committed themselves to making a better, lighter, stronger piston. While one of those two has since retired, Ken Roble still comes to work every day. He and his team still strive to not just be the best in the business, but, much like the company's vision 37 years ago, to continue to advance the product and the industry as a whole.



At first glance, a piston by itself might seem like a relatively simple item—there are no moving parts and they've been around for over a hundred years—how much can there be to improve on, right? Wrong. These unassuming chunks of aluminum are progressing in several key areas. We got in touch with Chris Madsen of Ross Racing Pistons to walk us through the ins and outs of the latest in piston manufacturing technology, and talked to two of our sport's preeminent engine builders—Jon Bennett of Bennett Racing Engines and Tony Bischoff of BES Racing to get the perspective from people who have pushed pistons to heights that were unimaginable a few years ago. Getting to the nitty gritty, there are two main areas that have been responsible for the largest advancements in the past two years. We'll discuss the larger of the two first.

### SKIRTING THE ISSUE

Perhaps the latest and greatest area of improvement is the piston skirt. "We have made major leaps in skirt design over the last few years," said Madsen, right off the bat. "The goal is to keep the piston stable throughout the entire cycle increasing ring seal and efficiency. This has become increasingly crucial in large-stroke engines where a large portion of the skirt comes out of the bore at BDC. If the piston is not stable during this direction change the piston will rattle, usually collapsing or gouging the skirt, which interrupts the ring seal resulting in blow-by, loss of vacuum and power." Madsen also noted that it's not just big-inch engines, but high-RPM motors that need increased stability while maintaining as light a weight



as possible, as well. Bennett added that it wasn't just the skirt design that has seen improvement, saying, "The ability to work in conjunction with Ross on skirt durability both from a friction wear and stability perspective has been a huge part of the overall advancement of our piston design. We can alter skirt shape and contact points depending on application. For example, we designed a specific piston for our solid steel blocks that had numerous changes that keep the skirts alive due to higher block temps and still retain really good ring seal." Through both computer modelling, and good old-fashioned R&D and testing, piston skirts are becoming lighter while being just as stable, if not moreso, which isn't just a reactive measure to handle today's power levels, but a proactive one, to help teams turn the screws to make more power, either by letting an engine turn harder or giving it more cubes, while staying alive longer, to boot.

**Whether you're looking for a set of replacement pistons for your mild street/street engine, or a radical high-compression powerhouse (or anything in-between) Ross Racing Pistons probably has a design to meet your needs. And with their extensive dealer network, they can put you in touch with the right people to get you anything really special that you could want.**



One of the largest areas of advancement in piston design, recently, has been the piston skirt. Critical to keeping the piston aligned in the bore, and maintaining ring seal, the balance of size and stability has seen some huge leaps forward thanks to both manufacturing advancements and R&D in the field from partners like Bennet Racing Engines and BES Racing.

## COMING IN FOR LANDING

The next aspect that has allowed the professionals to make bigger, better, and badder powerplants is the ring lands. "The precision machining of the ring grooves, and ability to put together almost any ring package I can dream up has been a huge step forward," said Bischoff. Now you might be asking yourself, "Ring grooves?" A few paragraphs up, Madsen mentioned that the skirt was critical in keeping the piston square in the bore to maintain seal. Well, the flatter and truer a ring groove is, the better seal it makes, so the better base you start with, the better the piston performs across the board. "A flat and true ring groove is just as important in creating optimal ring seal and vacuum," Madsen explained. As machining technology advances, the ability to not only put any size ring groove, in almost any location exists, but the ring groove itself can be held to tolerances that would make NASA proud. Improvement in any of those aspects alone would increase the ability to seal, and thereby the efficiency of the engine, but it also allows another factor to come into play—the human factor.

With such precise manufacturing capabilities, Ross

Advanced CAD and finite element analysis software has allowed Ross Pistons to be able to profile the underside of the piston to within thousandths of an inch to get every last gram of extra weight out of the piston.

Racing Pistons can let guys like Bischoff and Bennett think outside of the box in ring package design and take their ideas from the drawing board to hanging off a rod with ease. "I wouldn't say I can go crazy," laughed Bischoff. "But having the parameters for ring packages expanded in the past few years definitely allows for better piston design overall." Bennett agreed, and expanded on Bischoff's sentiment. "Standard aftermarket pistons will use 1/16-inch, 1/16-inch, 3/16-inch ring packages. However, with Ross, we have a lot of choices on our side .043-inch, 1.2mm, 1.5mm, and 0.9mm, for example. The thickness choice will be based on application as well as what ring style and radial thickness is available in that thickness. We also can adjust ring radial thickness as well, which lets us play with ring tension [drag in the cylinder], and in some cases allows us to run deeper valve pockets if needed," explained Bennett. Now, the significance of the improvements in the ability to machine ultra-precision ring grooves is starting to become more apparent. You can't push the design envelope if you can't manufacture it, which has been the age old argument between machinists and engineers – on in this case, engine builders and parts manufacturers—since the beginning of time. Now, it seems that the two are more in sync than ever, and we are seeing the products of that in the form of insane engine output and amazing ETs on the racetrack.

## TRICKLE DOWN ECONOMICS

So far, we've talked about the realm of high-end custom parts, but how does that apply to the average customer who just needs a set of eight slugs for their non-max-effort engine? Motorsports manufacturing benefits greatly from "trickle down" research and development, especially when it comes to pistons. First, let's look at a few aspects of the manufacturing side.

In years past, a "custom" piston meant not just more money, but a longer lead time. Several aspects have greatly reduced the time from order to delivery. With every year in business, Ross adds designs to their library that only need to be loaded from one computer to another in order to produce the desired piston. As that library increases, the amount of ready-to-go, "scienced-out" advanced piston designs easily available to the customer increases. About 80-percent of



Ross' business is custom pistons, and with their dealer network, even the smallest shops have access to some serious engineering and technology assets. Madsen elaborated, "We serve a lot of smaller shops. Even when an individual calls, we try to put them in touch with one of our dealers that specialize in the type of engine they are building. Not because we don't want to deal with them, but because we are trying to save them money and possibly mistakes. One of our dealers can save them money on parts and also share some of their experiences, saving headache by avoiding common pitfalls." Secondly, as manufacturing processes and technology continues to improve even the more basic, off-the-shelf designs benefit from improved tolerances and better ring packages available, thanks to the better ring grooves not requiring special processes or treatment.

From the engine builder's perspective, it makes it far less labor intensive on their end to order a set of "custom" pistons for a customer: "It's far easier to order a custom piston than it ever has been," said Bischoff. "I can get pretty much anything I want." That means that for less lead time on a customer's project, less cost in time spec'ing out a design, as outside the realm of max-effort stuff, a design more than likely already exists in the library, and an overall better final part. Bennett also exposed another benefit to the nearly unlimited options available to him. "We can alter the bore size .001-inch increments, so if we are freshening a customer's engine that is 4.125-inch bore, after honing the cylinders we can order new pistons at 4.127-inch, extending the usable life of the block. The biggest misconception the racer or consumer has, is that if their block is 4.125-inch bore and they need a rebuild, that they have to bore to 4.155-inch for the next size up piston." Being able to increase an existing piston design by the thousandth of an inch means that, barring catastrophic damage, a block can be "touched-up" many more times than having to go .020-over each rebuild.



Besides being able to reduce drag in the bore and overall weight of the piston with advanced piston skirt profiles, the advanced ring pack designs and ability to locate them wherever is needed, can allow for larger valve pockets in the piston. While that may not seem like much, it greatly frees up talented engine builders to design outside of the box.



A longtime method of increasing ring seal, gas-porting the pistons is still a viable method to enhance performance. The improvements being made to the ring pack design, and ring grooves themselves only further enhance the benefits of gas-porting.

So what does the future hold? Madsen isn't tipping his hand, saying, "Technology doesn't stop so we are always looking towards the future for new technology and tools to improve our product." Bennett was similarly tight-lipped on specifics, but would share this: "We are constantly upgrading our piston designs through R&D. I am sure there will be changes and advances we will see and develop in the future. At the end of the day it's like anything else: you wish you knew today what you will know 6 months from now, and piston development is no different. We will just keep trying to stay ahead by continuing our relentless engine R&D program."

If the past few years are any indication, ring packages will become even more refined, as will both skirt designs and coatings. Madsen does admit that there are a few very rare circumstances that might currently preclude them from being able to make a given design, but they don't just tell the customer "no". Madsen explained, "Most of the time if there is some circumstance that prevents us from making something, we know someone who can and we can pair them with the customer." With partners like Bennett Racing Engines and BES, and the company-wide focus on constant improvement, Ross Racing Pistons is sure to stay in the winner's circle for a long time to come. ■

## SOURCE

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