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Automotive Cam Grinding Workhorse Helps S&S Cycle Make American V-Twin And "...All Bikes Go Faster"

What began in 1952 with George Smith's quintessentially American desire "...to make all bikes go faster" has grown into an international competitor in the performance motorcycle market. Today, S&S Cycles of LaCrosse, Wisconsin supplies everything from custom air intakes to complete race-winning engines for American V-Twin enthusiasts in North America, Europe, Asia, and Australia.

"You will find S&S performance products anywhere in the world American V-Twin powered bikes are ridden," notes manufacturing engineer, Tim O'Toole, "and, that's quite literally everywhere in the world. We supply everything from individual components up to and including complete street-performance and Pro-Stock
racing engines for riders who share Mr. Smith's passion for making bikes go faster.
"In fact," he added, "one of our engines powered the Buell motorcycle that won the NHRA Pro-Stock bike championship this year. You will also see them on many custom bikes from places like West Coast Choppers, Orange County Choppers, Big Bear Choppers, Zero Engineering, BigDog Motorcycles, Arlen-Ness, Baker, and many others."
With the exception of pistons and valves, all of the major components of an S&S engine including camshafts, cylinders, flywheels, connecting rods, heads, and crankcases are manufactured in-house. An intense emphasis on quality, tight control of tolerances, and the use of premium materials are the keys to producing
components that can double the horsepower of a near-stock displacement engine.
"Heads and other components will generally fit a stock engine," O'Toole said, "and displacement can be
changed by replacing the flywheel assembly or cylinders. Camshafts, carburetors, and fuel injection components can also be upgraded.
"So, an owner can build a moderately high-performance engine one part at a time. But, for really high performance the crankcase will have to be replaced at some point as well, and then you have essentially a brand new, non-stock engine."

Once they get past simple modifications like changing air intakes, most owners begin the process of a serious horsepower upgrade by installing a new camshaft.
"Camshafts are usually one of the first upgrades someone does to their American V-Twin engine," says S&S Production Programmer, Paul Turgasen. "They are a healthy business for us, outside their use in our own
engines.
"The aftermarket cam market is very competitive, with lots of small specialty shops and a few that are pretty large as well," O'Toole added. "The combination of S&S' reputation in the industry, and the proven quality of our products gives us a competitive advantage and a growing share of the market."
That large and growing market share is one of the reasons why S&S decided to bring cam production completely in house a few years ago. To do that, they had to add a cam grinder to their machine tool inventory.
"We weren't interested in re-inventing the wheel," O'Toole explained, "we just wanted to get into the camshaft manufacturing business. So, we did some investigation into the various machines that are available and we kept getting the same answer. People would either ask us if we had a Landis cam grinder, or tell us that we needed one.

"Because this was our first experience with cam grinding, we wanted to be involved in the whole process of designing and building the machine so we would

understand it as completely as possible. That meant we wanted something built here in the United States, not something pieced together from a global basket of components and then adapted to our needs.

"We also wanted to be able to talk to the people building the machine and have first-hand contact through out the process. In the end, Cinetic Landis was the only company we considered that met all of our
requirements, and we ordered a 3L CNC cam and crank grinder from them."
The Landis 3L is actually designed for production cam grinding, and is widely used in the automotive
industry. It features hydrostatic ways and spindle bearings, and linear motor technology to provide fast,
precise response and long life with minimum maintenance requirements.
"Actually, we initially ordered a Landis LT1 grinder," O'Toole said, "but, at the time we were seriously
considering grinding our own crankshafts as well as camshafts and the 3L model gave us the ability to do that on longer parts than the LT1. As it turned out, we eventually decided not to bring crankshaft grinding in-house just yet, but the 3L gives us the option."

S&S uses superabrasive CBN wheels to grind both lobes and journals on the 3L. The machine also has
automatic wheel balancing, an acoustic sensing system, and sophisticated in-process gauging.
S&S Cycle's cams are ground from billets of 8620 steel, with journal tolerances of ±0.0003" to 0.0005" and lobe tolerances of ± 0.005". The 3L is equipped with a hydraulically-powered diaphragm-type chuck and a set of retractable centers. Journals are ground with the camshaft between centers, and it is then chucked for the cam profile grinding operations.
"Most high-volume applications use separate grinders for journals and lobes," O'Toole said, "but it makes more sense for us to do both on the same machine. Cinetic Landis designed the chuck/center system to
accommodate our needs, and it's working very well for us."
"We're using Cinetic Landis' Tetra 4000 software to produce control programs for our camshafts," Turgasen said. "It gives us the ability to smooth out the profiles, generate a workspeed and feed program, and also do a thermal analysis of the grinding process. All of those things directly impact quality, and Tetra 4000 lets us control them very precisely."

S&S purchased an Adcole cam and crank inspection machine as part of the process of gearing up for in-house camshaft production. They used it to analyze their existing products, as well as some non-production cams they had developed, while the 3L grinder was being built. That data formed the basis for the initial control programs developed for the 3L.
"We have a fully-staffed R&D department," notes R&D engineer, Dave Jensen. "We can do complete
valve-train analysis, camshaft design, and dyno testing in-house. That gives us the ability to validate
everything we design."
S&S Cycle's manufacturing operations run on a 5-day/2-shift schedule to meet demand for their products. That leaves the 3L grinder available for R&D, new product development, and special projects.
"We also use the Tetra 4000 software in our work," Jensen continued. "It helps us create and evaluate
experimental lobe profiles quickly. Then the most promising ones are smoothed with Tetra 4000 before we develop the workspeed profile for the 3L. It's really efficient."

"Our future plans include expanding outside the V-Twin market to cover more PowerSports applications including other motorcycles, 4-cycle snowmobiles, and ATV's of all kinds," O'Toole said. "Many of those
products will be able to take advantage of the 3L CNC grinder's ability to handle longer workpieces.
"Based on our experience to date, if we do encounter any kind of manufacturing bottleneck, it won't come from the 3L. Making '…bikes go faster' is only the beginning of what the grinder will help us accomplish in our next 50 years."