SUNNEN®
ABOVE AND BEYOND HONING

SINGLE-PASS HONING IS SINGLE SOLUTION FOR ACCURACY, PRODUCTIVITY AND PROCESS CAPABILITY IN MACHINING VVT STATOR BORES

PROCESS CAPABILITY EXCEEDS 1.67 C_{PK} WITH JUST ONCE-A-WEEK ADJUSTMENT, WHILE CHURNING OUT 4000+ PARTS PER DAY.

4-spindle VSS-2 honing system used by Cloyes Gear to hone the bores of VVT stators. The segmented bore of the powder metal parts is finished to a roundness of 50 microns and total tolerance of 80 microns.

SUBIACO, AR – What's not to like about a machining process that hits print tolerances with adjustment-free, 1.67 C_{pk} capability, while running 4000+ parts per day, six days a week? That kind of worry-free production of 50-micron roundness and 80-micron total tolerance made a Sunnen VSS-2 Single Stroke® honing system the process of choice for Cloyes Gear and Products in machining VVT (variable valve timing) stator bores for OEM automotive customers. The new four-spindle machine came on line at Cloyes' Subiaco, Arkansas, plant in early 2009 to replace a roller burnishing process that struggled to hit print tolerances. The new machine simplified the sizing of the segmented bore, eliminating a high scrap rate and headache for the plant.

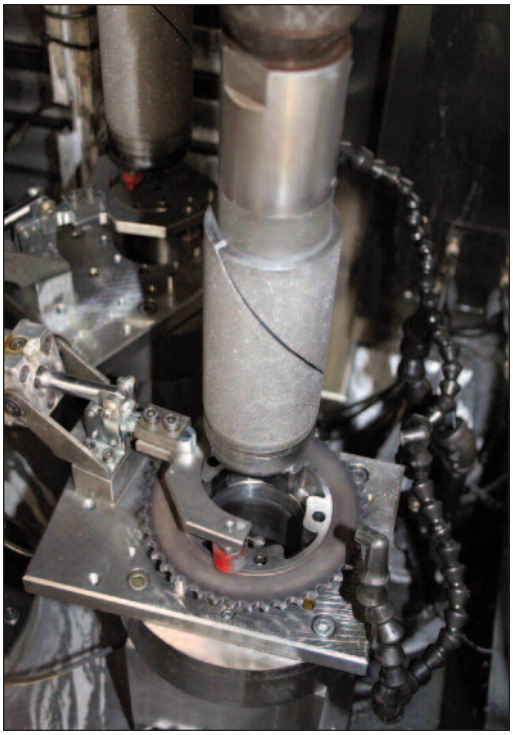
Cloyes Gear and Products, Inc. is a major automotive tier one supplier. The company's aftermarket division also offers a complete line of replacement timing drive systems and components, and Cloyes enjoys an excellent reputation in the performance community as well.

The Subiaco plant is home to the company's powder metal (PM) production facility, meeting OEM demand for lightweight, high-strength components in high volume. Cloyes controls the complete PM production process, both primary and secondary operations, employing press sizes of 60-825 tons, allowing the company to hold the highest standards of quality and constantly stretch the limits of the technology. Materials processed include iron, phosphorous iron, nickel/copper/steel add-mix, pre-alloyed, copper infiltrated, tungsten carbide/bronze matrix and stainless series 300/400. Part densities up to 7.5 g/cc are achieved. Key capabilities include sintering to 2250° F, hardening (induction, carburizing and carbonitriding), and a full range of secondary operations including steam bluing.

The Subiaco plant produces two different VVT stators for a single customer. Both parts are made of sintered steel with a hardness of 45 HRA. The stator's minor ID is made up of five segments constituting a bore that must be sized and finished after induction hardening in order to achieve a specified 50 microns roundness and 80 microns total tolerance. "We could turn this ID in a lathe, but it would be very challenging on a production basis because of the highly interrupted bore," said the process engineering manager at the plant.

"We originally processed the part with roller burnishing, but found it difficult to hold the desired roundness and process capability, resulting in a high scrap rate," he added. "We had a high level of confidence in single-pass honing based on three Sunnen machines in our plant already, so we purchased the company's new VSS-2 machine with four spindles, and integrated it with an automated part load/unload system."

(continued)



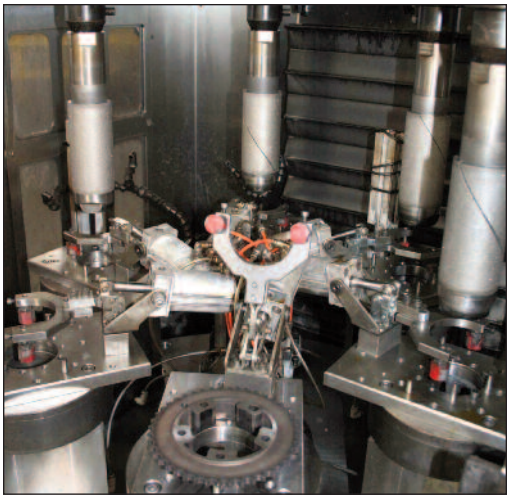
Parts are automatically clamped and fixtured on the rotary table of the honing machine.

How single-pass honing works

When properly applied, single pass honing is a quick, cost-effective method to get a precise bore size, geometry and surface finish. Parts made of cast iron, powdered metals, ceramic, glass, graphite and other free cutting materials – with L/D ratios up to 1:1 – are ideal for the process. The L/D ratio for the Cloyes VVT stator is 23/84 mm. Single-pass bore sizing is also appropriate for splined bores or longer L/D ratios if cross holes or other interruptions are present to allow chip flushing.

The VSS-2 Single Stroke® Honing system was introduced at IMTS 2008. It has the most accurate spindle alignment in the industry, according to the builder, combined with flexible, easy-to-use controls. Spindles on VSS-2 machines are factory aligned, independently, for precision centering with the tooling plate. This produces better bore geometry than possible with earlier machines that used an "average" alignment for all the spindles. Alignment accuracy exceeds DIN 8635 requirements for vertical honing machines. VSS-2 Series machines use up to six spindles to progressively size and finish part bores, using diamond tools of preset diameter and grit size. The control allows the column feed and spindle speed to be varied throughout the cycle. Operational flexibility is enhanced by the use of six available stroke profiles, including pecking, short stroke and dwell, which are easily added to a setup.

The VVT stator starts as powdered steel, which is pressed, sintered and sized in a restrike press. A small hole is drilled near the periphery of the part, then the teeth are brush deburred and induction hardened before honing. The bores require removal of about 0.076 mm (0.003") material, so each of the four spindles takes off a little less than a 0.025 mm (0.001"). Tool life is around 80,000 parts, according to the process engineering manager. After honing, the parts are face ground, deburred, washed and packed. In operation, the VVT stator interfaces with a rotor that moves about 15 degrees to adjust valve timing for optimum engine performance, based on RPM and other parameters.



The honing machine uses four diamond honing tools to progressively remove 0.076 mm (0.003”) of material, running approximately 4000 parts/day with 1.67 Cpk process capability.

Like its other honing machines, Cloyes interfaced the new machine with a part feeding system that includes Fanuc M-6i robot, allowing the machine to run essentially untended 22 hours a day. "This system is all about short cycle time, high production rates, and high process capability, all without babysitting the machine," said the process engineering managers. "We might need to make an adjustment once a week to keep the parts within spec. That's the kind of productivity and process capability needed to be competitive in the OEM automotive market these days."

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