

Single-Pass Honing Holds the Line on P/M Sprockets

BORE FINISHING SYSTEM FROM SUNNEN HELPS CLOYES GEAR AND PRODUCTS ACHIEVE HIGH ACCURACY, PRODUCTIVITY AND PROCESS CAPABILITY

William R. Stott,
Managing Editor

As a Tier One automotive supplier, Cloyes Gear and Products Inc. relies heavily on the productivity and accuracy of its manufacturing processes. At the company's facility in Subiaco, AR, one line churns out 4,000+ parts per day, seven days a week. Keeping the machines running—while hitting the required print tolerances—is how Cloyes maintains its competitive advantage.

One key process for Cloyes is the machining of bores on the company's



The VSS-2 Honing System from Sunnen helps Cloyes Gear maintain productivity and process capability in the manufacture of its variable valve timing stators.

VVT (variable valve timing) stators for OEM automotive customers. These parts require 50-micron roundness and 80-micron total tolerance. In the past, the company used a roller burnishing process to finish these bores, but it struggled to hit the print tolerances.

“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,” says Justin Carty, process engineering manager at the plant.

The Subiaco plant is home to the company’s powder metal production facility. Cloyes controls the complete PM production process, employing presses ranging from 60–825 tons for both primary and secondary operations. Employing state-of-the-art technology, the company is able to achieve part densities up to 7.5 g/cc. Key capabilities include sintering to 2,250 degrees Fahrenheit, hardening (including induction, carburizing and carbonitriding) and a full range of secondary operations.

The Subiaco plant produces two 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 the specified 50 microns roundness and 80 microns total tolerance.

The company considered turning the ID on a lathe, “but it would be very challenging on a production basis because of the highly interrupted bore,” Carty says.

So in 2009, Cloyes installed a new four-spindle Sunnen VSS-2 Single-Stroke honing system on the VVT line. The new process allowed the company to simplify the process of bore sizing while at the same time, significantly reducing its scrap rate.

“We had a high level of confidence in single-pass honing based on three Sunnen machines in our plant already,” Carty says, “so we purchased the company’s new VSS-2 machine with four spindles and integrated it with an automated part load/unload system.”

How Single-Pass Honing Works

When properly applied, single-pass honing is a quick, cost-effective meth-

od 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 length-to-diameter ratios up to 1:1—are ideal for the process. The length-to-diameter ratio for the Cloyes VVT stator is 23:84 mm. Single-pass bore sizing is also appropriate for splined bores or longer length-to-diameter 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. According to Sunnen, it has the most accurate spindle alignment in the industry, along 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 previous machines,

which used an “average” alignment for 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. Standard stroke profiles, including pecking, short stroke and dwell are programmed into the controls, allowing operators to easily add them to a part setup.

The VVT stator starts as powdered steel, which is pressed, sintered and sized in a restrrike 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

continued



The honing system at Cloyes' Subiaco plant employs four spindles and an automated part load/unload system. VSS-2 machines can be equipped with up to six spindles.

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four spindles takes off a little less than 0.025 mm (0.001"). Tool life is around 80,000 parts, according to Carty. 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.

Like its other honing machines, Cloyes interfaced this machine with a part feeding systems that includes a 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," Carty added. "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." ⚙️

For more information:

Bob Davis, Global
Communications Manager
Sunnen Products Company
7910 Manchester Ave.
St. Louis, MO 63143
Phone: (314) 781-2100
bdavis@sunnen.com

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Each spindle removes about 0.025 mm from the bore.