

# Drive & Control profile

## Sunnen's New Stroking System Benefits from Bosch Rexroth Ball Screw



Ball screws achieve multiple Gs of acceleration with very high linear cycle speeds to meet the rapid reversal move profiles in the new Sunnen design.

Greater speed, control and accuracy achieved with unlikely technology. "The honing process is often considered a mystery because many people don't understand how it works," noted Jose Martin, senior mechanical engineer at Sunnen Products Company, who described honing as the removal of small amounts of material after boring out high-precision parts

such as fuel injectors. "Sunnen has perfected honing with years of experience. We add the science to the magic. We understand the technology behind it, and we know how to use it."

Sunnen has long been a leader in industrial bore sizing and finishing machines, catering to many high profile U.S. customers,

### Challenge

Improve stroking machine productivity, accuracy and bore finish through use of new technology

### Bosch Rexroth Solution

- Rexroth Ball Rail® System

### Benefits

- Ball rails and screws improve productivity in honing applications
- Highly rigid rail guides enhance stroking tool linear accuracy
- Increased honing speeds – up to 150 meters per minute
- Machine productivity improved through high stroke capacity, reduced vibrations, and high position repeatability



The SV Series, including the SV-200 and SV-1000, features the new tool stroking system with ball screw motion control to produce a true vertical stroke, resulting in greater control and higher accuracy in bore size and finish.

including the “Big Three” automakers, Caterpillar, and Cummins. Recently, what started out as an internal research project for Sunnen to improve machine productivity concluded with a significant shift to using ball screws and rails for the tool stroking process in their new machines—a major divergence from their traditional cam-driven machines. Martin is just one of many at the St. Louis-based company who are excited about the significant improvements in speed, control and accuracy the machines are able to achieve using motion control products from the Bosch Rexroth Corporation’s Linear Motion and Assembly Technologies group.

### **Honing In**

Generally, bore sizing and finishing involves a diamond or CBN cutting tool, which is passed through the bore while the tool is rotating and removes a specific amount of

material. Sunnen has further refined the honing aspect of this process with its tool stroking system. In simple terms, tool stroking works like this: The part, a fuel injector for example, is presented to the cutting tool on a spindle. Either the part or the spindle reciprocates back and forth, so motion occurs relative to the part. As the part is “stroked,” the tool expands, removing small amounts of material. Because part geometries are becoming increasingly complex, bore non-uniformities along the axis of the bore need special motion control afforded by this stroking system to generate the highest precision finished product. To achieve tight tolerances, the part must be allowed to move, or “float” within three axes. This movement is the single most important feature of the honing process, making the high flexibility of the ball screw ideal for complex parts.

Previously, Sunnen was using cam-based technology in their vertical honing machines in which a cam profile was generated mechanically via four bar linkages, but the company wanted improved performance while maintaining valuable uptime for its customers in case of a breakdown. Sunnen also wanted to maximize L10 life (machine life of 30,000 hours under the worst load conditions), minimize the total number of parts in the machine and, finally, apply the technology across a variety of its machines. Rexroth ball screws and rails enabled Sunnen to realize all of these goals and more.

Given the perceived challenges of using ball screws in a honing application, such as the short cycling motion and high number of strokes per minute, no one thought the control and productivity goals were possible. According to Russell Jacobsmeyer, Sunnen manager of product design and development, Rexroth was one of surprisingly few companies willing to work with Sunnen to investigate the ball screw technology for increasing productivity in honing applications.

“Rexroth is a lot like us,” reflected Jacobsmeyer. “They want to help solve customers’ problems. Their customer service in all aspects was outstanding. We are thrilled with the final product and its performance.”

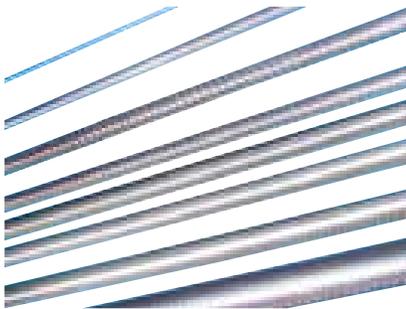
### **Ball Screw Benefits**

The key advantages provided by ball screws include higher speed and more rigidity. In this case, the ball screw drives the stroking mechanism of the honing axis and is connected directly to a servomotor. Ball screws are ideal because they can achieve multiple Gs of acceleration with very high linear cycle speeds to meet the rapid reversal move profiles in the new Sunnen design. In general, Rexroth’s ball screws perform at speeds around up to 150 meters per minute. The high rigidity of the ball screw means the strokes and dwells of Sunnen’s heavy honing mechanism are controlled as needed. In addition, adding Rexroth Ball Rail guides helps maintain linear accuracy during the stroke to ensure accurate

positioning of the honing spindle during travel.

“Ball screws reduced part quantity by a factor of ten,” said Martin. This, plus the increased control, increased accuracy, decreased vibration and increased velocity, was a huge benefit according to Martin, who also noted that assembly time is reduced due to fewer components and field repairs are simplified with only three areas to troubleshoot: the ball screw assembly, the coupler, and the servo system. “The machine capacity is much more flexible with a simple replacement of the ball screw or the motion profile,” added Martin.

Rexroth’s precision ball screws used by Sunnen have enclosed ball-circulation systems with a large number of balls, and feature screws that offer more rigidity, high axial load capacity, and low friction to achieve repeatability, precision, and smooth operation. Performance quality is also attributed to the design of the internal recirculation and the optimal lift-off of balls from the raceway.



Bosch Rexroth precision ball screws are available in diameters from 8 to 125 mm, leads from 2.5 to 40 mm, and lengths from 8000 mm or more.



Bosch Rexroth’s precision ball screws used by Sunnen have enclosed ball-circulation systems with a large number of balls, and feature screws that offer more rigidity, high axial load capacity, and low friction to achieve repeatability, precision, and smooth operation.

“The combination of high stroke capacity, low vibrations, and high position repeatability gives us a new competitive advantage,” said Martin. “Plus, our patent-pending tool stroking system is a common platform approach that we can apply in other machines as well. We used Rexroth’s products in a unique way to solve a problem, and the process control we can now achieve helps us realize a dramatic increase in productivity compared to previous technologies.”

#### **Sunnen’s SV Series Showcases New Stroking System**

The fruits of Sunnen’s labor are evident in the company’s new SV Series vertical honing systems. The SV Series, including the SV-200 and SV-1000, features the new tool stroking system with ball screw motion control to produce a true vertical stroke, resulting in greater control and higher accuracy in bore size and finish. It can also achieve a consistent crosshatch pattern throughout the entire length of the bore—a result that was incredibly difficult to achieve until now, as the new design allows the machine to dwell in any part of the bore, end-to-end, selectively removing stock for the straightest, most precise bore possible.

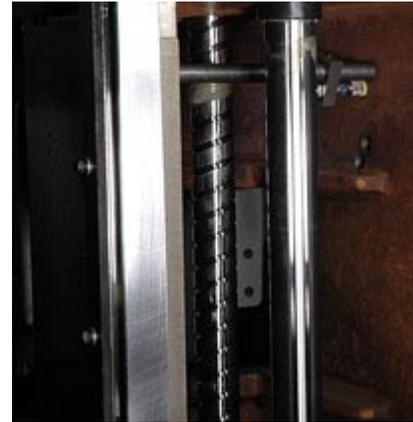
For fast, easy setups, the SV machines feature a 3-axis hand wheel control. The SV-200 machine utilizes the hand wheel for fine-tuning of the vertical stroke position and the honing tool feed position. The lateral column position can also be adjusted through a servomotor with the same hand wheel for parts with multiple in-line bores, but the parts do not have to be in-line, such as for “V” style engine blocks or rotary compressor blocks. The SV-200 is ideal for precision, medium to high volume production honing of bores between 19 and 200 mm in diameter. Applications include diesel cylinder liners, engine blocks, construction and military hydraulic blocks with multiple bores, AC compressors, 2-cycle engines, gear hobs, large valve bodies, brake drums, landing gear components, large connecting rods and bearing sleeves. A choice of two tool feed systems (rotary or linear) for versatility in tooling selection is also available.

The SV-1000 was designed for precision medium to high volume production in small bores, 3 mm to 65 mm in diameter. Applications include fuel injectors, fiber optic components, fuel pumps, hydraulic cartridge valves, hydraulic valves blocks, medical devices, pistol and

machine gun barrels, connecting rods, refrigeration components and gear hobs. Other features of the SV series include removable sides to facilitate the adding of automated parts loading and unloading, and a choice of coolant systems.

Jacobsmeier added that Sunnen's customers are often in a battle for who can make parts most efficiently, however it's Sunnen's quality output that is a differentiator from other honing machines.

"Some of our customers say our competitors can't touch what they can produce with a Sunnen system," said Jacobsmeier. "Precise size, surface finish, roundness, straightness and consistent surface texture are all Sunnen hallmarks, so we had some pretty high standards to live up to when investigating new technologies. Ultimately, Sunnen and Rexroth did what no one else thought was possible."



Bosch Rexroth ball screws and rails maximize L10 life, minimize the total number of parts in the machine and enable Sunnen to apply the technology across a variety of its machines.

**Rexroth**  
Bosch Group