Hydraulic Piston Pump Application

“Above & Beyond Honing”

Executive Summary

Honing is an abrasive machining process that is the "best kept secret" at many piston pump manufacturers, whether the end product is for Aerospace, Agricultural, Automotive, Construction, Oil & Gas, or the Mining Industry. Sunnen has developed technology for piston pump honing solutions that help manufacturers be more productive. These solutions can include full automation with robot loading and air gage feedback so that the parts are loaded and unloaded from a conveyor or pallet. Manually loaded solutions are also available. Simply put, honing requires less operator involvement today and produces a more accurate cylinder – a better overall product – for lower cost!

Honing improves cylinder performance by producing more uniform and controlled bore geometry, size and surface finish. Honing improves straightness, cylindricity, and roundness. It corrects taper, bow, barrel shape, tight spots and other geometric errors better than boring or reaming. Honing consistently produces surface finish to specifications. With its self-sharpening abrasive tooling, honing eliminates tool condition and wear as a manufacturing variable.

Honing is used after the machining process to correct bore geometry problems and establish the correct surface finish and texture. The secret to good bore geometry lies in the honing tool design, the abrasive selection, the coolant, and the honing machine feed system control. And with today’s CNC controls, honing is a true production process – fast, low-cost, highly consistent, easily automated, and requires no special skills or touch.

Leading Piston Pump manufacturers rely on Sunnen honing systems, including Hamilton Sundstrand. The following article provides details.
Application Summary – Hydraulic Piston Pumps

Sunnen Products Company has ‘cracked the code’ for production of Axial Piston Pumps! An Axial Piston Pump manufacturer for the aerospace industry recently purchased a complete turnkey honing system from Sunnen Products Company. This system automatically hone all the bores in the cylinder block. The 3 step honing process involves a rough honing step, a semi-finish honing step, and a plateau finish honing step. In this application the 3 step process is used to generate a specific set of surface texture parameters needed for the proper function and product life required. The 3 honing columns are arranged around a rotary servo index table enabling unattended operation, saving thousands in labor costs for the manufacturer each month!

Axial Piston Pumps are positive displacement pumps that have a number of cylinders arranged in a circular pattern within a cylinder block. This cylinder block, also known as a rotor or a barrel, is a key component in the pump assembly. The size and surface texture of the cylinder bores is critical to proper pump performance and life of the assembly. Honing is a key process in obtaining the size, geometric form, surface texture, and finish required in the cylinder bores. Roundness below 1 micron (.000040 inch) and straightness below 2 micron (.000080 inch) are routine, along with tight control over Rpk, Rvk, and Rk values for exceptional bearing surface texture requirements.

There are many varieties of piston pumps including Axial Radial Inline Piston pumps, Radial-Piston Pumps, and Plunger Pumps. The requirement that these pump designs have in common is that the fit of the piston and the cylinder must be precisely controlled. The surface texture characteristics of the cylinder bore are also precisely controlled to extend the life of the cylinder block assembly before requiring service. The answer to both of these common requirements is “honing” – more specifically, Sunnen Products Company honing solutions.

Aerospace Piston Pump Cylinder Application
In the Aerospace Piston Pump Application, the manufacturer’s goal is to improve the life of the piston pump assembly. Current designs include a sintered bronze bushing in the cylinder block bores. The sintered bronze bushing enables the piston to reciprocate without seizing during high pressure operation. The drawback to this design is that the bronze bushings experience significant wear. Expensive scheduled maintenance must be performed regularly due to this design deficiency. When a 747 jet engine is involved, 4 piston pumps per engine must be replaced! The expense of this regular maintenance is obvious and the means to reduce it are in high demand.

The manufacturer found that pump life could be improved by “orders of magnitude” for the cylinder block if the sintered bronze bushing was eliminated. However, the hard steel cylinder block would not prevent seizing of the piston without a special surface texture requirement placed on the cylinder bore. This special surface texture is a “plateau honed” surface finish. Plateau honing involves a carefully engineered process combining the abrasive and tooling selection needed to generate a consistent and measurable surface texture result. The final honing step removes just enough material to simulate the break-in period that would result during pump startup, only without the resultant wear within the cylinder bore. Plateau honing generates a surface texture that has a typical honing crosshatch pattern in the bore. In addition, Plateau Honing generates a surface texture with better load bearing characteristics by allowing better lubrication along the cylinder bore surface. A similar process is used in the combustion engine cylinder design for automotive applications, and has extended engine life by thousands of miles per engine block!

The manufacturing process previously used to hone these hard steel cylinder blocks required labor intensive manual honing operations. A typical cylinder block contains 9 cylinder bores. Production output per honing operator was 2 parts per shift. The turnkey honing process produces 2 parts in 36 minutes without a full-time operator. The CNC machining centers and the honing system are contained within a cell and all are tended by one operator. The cycle time savings alone is 3.7 hours per part! Assuming the manufacturer produces 10,000 cylinder blocks per year, an annual savings of 37,000 man-hours results. Assuming labor costs of $50 per hour (with fringe benefits included), a savings of $1,850,000 can be realized in the first year alone!

In case you were wondering, the tolerances on this application are quite demanding. In addition to the tight tolerances, the bore is blind! This means the bottom of the bore will not allow the tool to extend through. For other honing manufacturers this presents an extremely difficult problem to overcome. Sunnen Products Company, however, is a vertically integrated honing solution provider. The complete Honing System - Machine, Honing Tool, Honing Abrasive, Work piece Fixture, Gauging, and Coolant are all supplied by Sunnen Products Company. All these elements are combined into a honing system that can generate the desired tolerances automatically and unattended. The bore tolerances are less than 1.5 microns roundness (.000060 inch) and 3 microns straightness (.000120 inch). Production parts honed on the Sunnen Honing System are well within these tolerances, resulting in high Process Capability with dependable production day-in and day-out!
Summary

Sunnen Products Company is the world’s largest vertically integrated manufacturer of precision bore sizing equipment and tooling. Our team of dedicated research and design engineers provides solutions for our customers. Providing solutions to improve the performance of our customers fulfills our corporate mission. Piston pump applications come in a wide variety of sizes, shapes, and tolerance requirements. Aerospace, Agricultural, Automotive, Construction, Oil & Gas, and Mining Industries all provide potential piston pump applications. Honing is applied to all materials from Alnico to Zinc! Piston pumps, no matter the size or material, can be processed on Sunnen Honing systems. Better production quality and lower costs are the result. Sunnen Products Company has the solution!

Sunnen Products Company – a brief history

Sunnen Products Company is the world's largest vertically integrated producer of honing machines, abrasives, tooling and coolants. A leading supplier of technology for small engine manufacturers, the company was founded in 1924 in the U.S. by Joseph Sunnen, a man who was truly ahead of his time in many ways. His initial creative genius was geared toward the repair of automotive engines to improve the productivity of the automotive repair shops of his era. Over the ensuing years Joe sought to improve the performance of industrial products using the honing process. This work led to the development of honing tools, gages, machines, and processes capable of yielding bore accuracies of ten millionths of an inch (¼ micron), in a production environment!

With more than 600 employees worldwide and global Sales & Service through 50 distributors, Sunnen has become a leader in fully automated flexible honing systems for medium to high-volume production. Standard products are also available from the extensive Sunnen Honing Supplies catalog for high, medium and low-volume production. With manufacturing control of its own abrasives, tooling, coolants and machinery, Sunnen Products Company is ideally positioned to offer "the best total solution" to its customers. No matter what the production requirements, Sunnen has a solution for you – all from one supplier!