

Early Honing Experience of Company President Pays Big Dividend for Hydraulic Valve Supplier



Jim Brizzolara, President and CEO of HydraForce, Inc., credits lessons learned on a Sunnen hone at his first job in 1966 in a hydraulic valve factory with helping him understand how precision bore finish and geometry can fine-tune the performance of a valve. Fast-forward to today, and Brizzolara has used that knowledge to help build the company he co-founded in 1985 into a leading supplier of cartridge valves and integrated circuit manifolds.

Brizzolara considers honing one of the company's core competencies, using it to give their products a quality edge in a market where cartridge valves are often considered commodities.

The company uses nearly 36 Sunnen conventional honing systems at its plants in the U.S. and U.K. The machines produce the final size and geometry of valve cages and other critical parts to <math><0.00005\text{-inch}</math> (0.00127-mm) accuracy, and customize the surface finish to specs tailored for various mating components used in the products. Brizzolara says precision size and surface finish on mating parts help eliminate leakage and ensure consistent performance on electrically actuated models under low-voltage conditions, often encountered with low batteries on mobile equipment.

The company uses conventional honing, which takes a little more time, rather than single-pass honing, which is a quicker and less-costly process. The process typically involves a roughing operation on Sunnen ML-5000 Power Stroke machines

and a finishing operation on CGM and KGM 5000 Krossgrinding® machines. Cubic-boron-nitride abrasive is used for roughing. Finishing passes typically use diamond-plated tooling on the Krossgrinding machines, which can control hole size to accuracies of 0.000010 inch (0.00025 mm). If Rk and Rpk surface values are critical, aluminum oxide or silicon carbide abrasives may be used on the ML machine.

Although the company uses stainless steel and other materials occasionally, most valve cages start as 12L14 or 12L15 steel that is carburized to about 60 Rc hardness after screw machining. "Any competitor can purchase screw machined components from suppliers just like ours, but what sets us

apart is our knowledge of how the final fit and finish on mating parts can be optimized with honing," Brizzolara explains. "Conventional honing can really make a difference in how a product performs. It's not just the size control; it's the surface finish and crosshatch

pattern you put on the bore of the cage. Our tight control of operations that produce the fit, finish, and clearance of mating and sealing components results in more efficient hydraulic circuit. Most machinists are pleased with a bore tolerance of 0.002 inch (0.0508 mm), while we are holding less than 0.000050 inches (<math><0.00127\text{ mm}</math>)."



Conventional honing gives a number of advantages for finishing valve cages, according to Brizzolara. A conventional honing mandrel – which contacts almost the full length of the bore while the part reciprocates – corrects any geometric error (straightness, cylindricity) from screw machining, or distortion from heat-treating or stress relief. A single-pass honing tool, on the other hand, is tapered, so the small area of the tool representing final size tends to follow path of the cage bore, making it less likely to correct a curved bore.

Conventional honing also produces a crosshatch pattern on the bore surface, while single-pass honing produces a helical pattern on the surface. "The crosshatch surface ensures a consistent full-length flow path for lubrication around the mating parts of the valve," Brizzolara says. "It's the same surfacing technology used

in automotive cylinder bores, particularly in performance racing."

In addition to the crosshatch, the company also measures and controls the surface roughness. "A superfine finish without crosshatch actually diminishes lubrication between mating parts, thus increasing friction," he explains. "We control Ra on our honing, and for certain parts will control Rk and Rpk (the mean height of the peaks protruding from the roughness core). The valleys improve lubrication, but the peaks cause friction, which leads to sluggish operation." The company customizes the surface roughness for optimum valve performance, based on the nature of the mating parts, i.e., O-ring, steel piston, etc.

Conventional honing also minimizes the need for deburring of the parts. Single-pass honing produces more burrs in the

cross holes of the cage. "Single-pass honing mandrels tend to fold, tear, and push more material, while conventional abrasive tools cut the material, though speeds, feeds, and pressures need to be controlled to achieve the best result," Brizzolara says. "We document these parameters to develop best practices, stick to them, then try to improve them as we go on."

All of the honing machines at the company have a two-fixture methodology for maximum in-cut time, allowing the operator to load one while the other is in the machine. Operators air gage every part after honing, and lot sizes run from a few hundred pieces to several thousand (honing is the only batch process in the plant due to cleaning requirements).

Part diameters range from 0.097 inch (2.46 mm) to just over one inch (25.4 mm). Final product performance is 100% tested in one of 60 product-specific test cells.

Although honing is only part of a much larger picture that includes grinding, cleanliness, assembly methodologies, and testing, Brizzolara says it is certainly a key enabler for the company's five-year product warranty.



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