Helander Metal Spinning Company

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Hydroforming Magnetic/Rotary Pumps

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Hydroforming is a widely used process that can cost-effectively shape a variety of ductile metals, including aluminum, stainless steel, brass, low alloy steels, copper, and aluminum. It is a specialized method of die molding, utilizing highly pressured fluid to form the metal into various shapes. Hydroforming is used for a wide variety of applications, including bicycle frames, saxophones, and many others.

It is also used to form products that are indispensable for industrial settings and in particular, rotary pumps. There are a large number of different centrifugal pump designs that are successfully being used today, and many of these are produced by hydroforming methods. One pump type that shows particular potential for hydroforming construction is the magnetic drive rotary pump.

Hydroforming 101

There are two basic classifications of this process, and these are sheet and tube hydroforming. The sheet process uses a sheet of metal and one die. The blank sheet is placed over the die and then driven into it by high pressure water on the other side of the sheet, forming the specifically desired shape. Tube hydroforming processes are similar but use two die halves instead. The entire process breaks down like this:

1. The raw sheet or tube is loaded into the hydroforming die press.
2. The press closes
3. For sheet hydroforming, the metal is formed into the shape of the die by the force of high hydraulic pressure.
4. For tube hydroforming, first the sealing rods engage the part. The ends are sealed and water pressure inside the part increases. The sealing rods then push the tube into the die, and then the internal hydraulic pressure is increased to its maximum value.
5. The sheet or tube takes on the full shape of the die.
6. The final hydroformed part is removed, and the process is ready to begin again.

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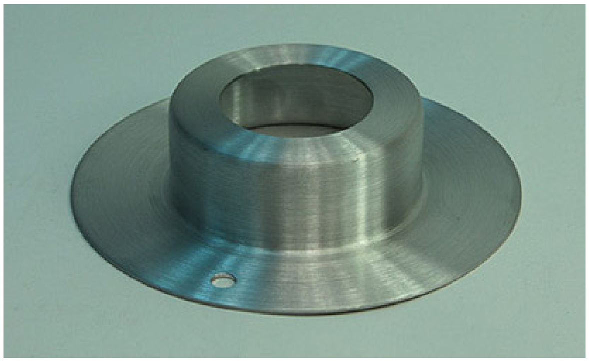
How Magnetic Rotary Pumps Operate



Magnetic drive rotary pumps have been in use for over 40 years. There are a number of different aspects to their basic operation. A cylindrical hub is mounted to the pump shaft. High strength magnets are contained within the outside diameter of the hub. The entire hub is either potted or canned in order to ensure the magnets are protected from the pumped liquid. The pump is sealed from external leakage with a can or containment shell around the pump hub. This can or containment shell must be made from a non-magnetic material such as Hastelloy or stainless steel.

A driven cylindrical hub surrounds the outside of the can, with its inside diameter also lined with high strength magnets. When this hub is rotated, the magnetic fields within engage the inner driven hub magnetic fields. Therefore, there is no physical connection to the drive while the pump shaft rotates, and a dynamic shaft seal is not needed. Cans are generally manufactured with thin walls in order to minimize the distance between the outer and inner magnets. These pump systems are the most cost effective when the magnets operate closely together, with can-to-hub clearances generally measuring 0.060” to 0.150” radially.

While there are a number of methods available for manufacturing these pumps, hydroforming is an ideal process. It can create products with a great deal of precision and tight tolerances. This is especially useful for magnetic rotary pumps, where the thickness of can walls usually ranges from 0.100” to 0.150”. Hydroforming also can avoid a number of difficulties that can arise from casting, which is a process that is often used for the fabrication of these pumps.

Hydroforming Avoids Casting Defects

Casting, a manufacturing process that consists of pouring hot liquid metal into a mold, has been in use for thousands of years. It has been and continues to be a highly effective method of fabrication for many different components, but can be problematic when used to manufacture magnetic rotary pumps. One of the difficulties involves the porosity that can occur.

Most die castings contain some degree of residual porosity. In addition, casting processes can suffer the possible defect of gas porosity, which occurs with the formation of bubbles after a casting has cooled. In any event, excessive porosity can cause liquid leakage from pumps. This not only makes a pumping system less efficient, but can result in system failure if the leakage is not caught in time.

This issue can be effectively addressed with hydroforming. This process allows for metalworking with naturally low levels of porosity, helping protect against potential leakage. Hydroforming is well known for creating excellent quality finishes, sometimes eliminating the need for additional finishing altogether. This also makes for a natural level of protection against leakage, in addition to its low porosity.

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A High Precision Process

Hydroforming is capable of producing parts with a high degree of precision. Its flexibility allows it to provide a wide array of simple and complex shapes by simply using hydraulic pressure. Conventional systems require extremely accurate tool alignment to achieve similar results. The hydroforming process allows for complex geometric parts to be formed with drastically reduced tooling. A single operation can create traditionally or irregularly shaped parts that require many additional steps using more traditional press operations.

This process, used to create so many complicated shapes in few steps, is perfect to create the canisters used in magnetic rotary pumps. The precise results achieved from hydroforming also come at significant cost savings. The matching male and female dies that are normally required in conventional processes can be eliminated in hydroforming. Savings are also seen in the reduction of finishing costs from conventional matched die methods. These come about from fixing scuff marks, stretch, and shock lines.

Unmatched Flexibility

The variety of parts and components that can be created by hydroforming is enhanced by its ability to work under high or low pressure. Low pressure operations are generally used to create parts with flat surfaces, large radii, and simple cross sections. High pressure hydroforming can create parts that conform to complex cross sections with smaller radii.

Another option that is available today is known as active hydroforming. This process is performed in several steps and is begun by having the part placed in the tool. A fluid pressure is then applied to expand the part before the tool is cycled shut, with the part holding uniform thickness all the while. The press is then cycled and the part is fully formed. A part created using this method can maintain a high level of complexity while keeping uniform thickness and form.

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Uniform Wall Thickness

Pumps made by hydroforming have the advantage of being made from consistently uniform, high quality components. The material finish and thickness of hydroformed components maintains consistency throughout, including minimal thinning out at the cross section of parts. This method creates bonding without seams. This not only produces consistent thickness but also increases the strength of each part.

Consistent thickness can be further enhanced by computer controlled processes that help eliminate torn and wrinkled parts. Adjustments can be made to programmable pressure and punch positions, offering the operator a very high degree of control in the production of custom components such as magnetic rotary pumps. Changes can be easily performed for settings that are producing imperfect parts.

These same simplified modifications help make hydroforming an ideal process for product development. Magnetic rotary pump components can be produced at varying levels of thickness on the same tooling. The employment of this process can help pump engineers and designers in perfecting their prototypes in a cost effective way.

A High Degree of Accuracy

Hydroforming allows for precision tolerances to be achieved with even the most difficult and complicated configurations. As long as the material being worked on exhibits normal spring back, inside measurements can be kept to tolerances of ± 0.005". These tolerances can be held to applications that require irregular contoured shapes. These shapes are easily formed, often in the same hydroform operation, as compared to conventional presses where the same shapes require two or three different operations. With tolerances that regularly reach as low as .020" and as large as .125", hydroforming can easily accommodate the necessary tolerances associated with fabricating magnetic rotary pumps.

A Cost Effective and Efficient Method

Hydroforming holds a number of advantages over traditional die casting methods. The process provides an exceptional finish, helps reduce costs, and can be performed at precision level tolerances. It also provides an improved process flow with decreased wear of the die. This is because the process is not metal-on-metal, but rather fluid-on-metal instead. The advantages of hydroforming make it particularly suitable for magnetic rotary pump manufacturing.

In addition, tube and sheet hydroforming can replace conventional stamping and casting assemblies, which require expansive assembly areas, large amounts of welding, and high maintenance costs. The seamless bonding produced from this process eliminates the need for much welding, while creating high quality parts that are strong, resistant to buckling, and have fewer surface defects. The long list of hydroformed parts that are currently employed throughout industrial sectors is well augmented by centrifugal pumps. The use of hydroforming for these pumps allows them to benefit immensely in component strength, finish, and precision.

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