Chilling Out with Sealless Pumps

Sealless pumps can reduce maintenance requirements and downtime, making them an attractive option for many chiller applications.

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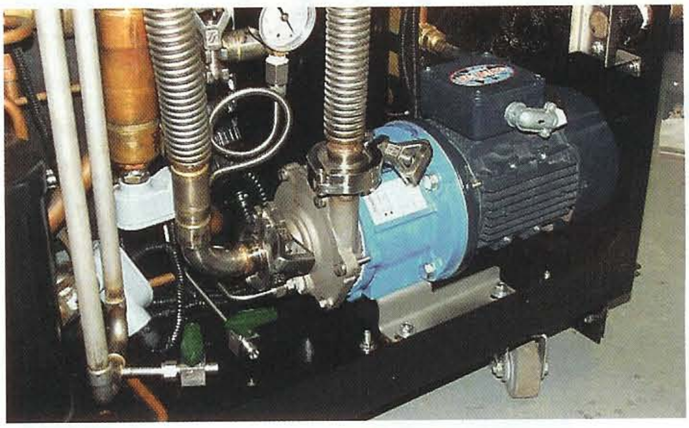


Image courtesy of Magnatex Pumps Inc.

A sealless pump is installed in a chiller system designed for pumping Dow Syltherm XLT silicone oil with a temperature range of -40 to 302°F (-40 to 150°C). The magnetically coupled centrifugal pump has a stainless steel casing, as well as a silicon carbide shaft and bushings to resist wear due to entrained particulate.

Sealless pumps are used in many industries, most commonly to avoid the leak potential of rotating mechanical shaft seals. The term "sealless" is actually somewhat of a misnomer — while sealless pumps do not have a rotating shaft seal, they usually have at least a gasket or O-ring, often located between the two halves of the volute casing.

Engineers typically do not use sealless pumps unless they have to because their physical size is usually larger than the conventional sealed pump models used in chillers, and their initial cost has been much higher historically. However, the overall cost of ownership of sealless pumps can potentially be lower compared to pumps with mechanical seals, especially if a facility's downtime and maintenance costs are significant.

The potential for leaks in a chiller system using sealed pumps commonly increases when:

- Extreme (cold or hot) fluid temperatures are involved, or rapid changes in temperature occur.
- The fluid has a low viscosity or low surface tension, or is otherwise described as "elusive."
- Particulate is present in the fluid, whether introduced or generated within the system. Particulate and debris can build up or cause scratches on the faces of mechanical seals and cause a leak.
- Mechanical seals have proven to be unsuccessful.
- Traditional static elastomeric/polymeric seals have often failed.

The negative consequences of leaks can include:

- Flammable, toxic or otherwise hazardous fluids released into the plant's operating environment.
- Increased liability.
- The potential for local electronic chemical sensors to trigger a warning requiring system shutdown or building evacuation.
- Reduced equipment production uptime due to system shutdowns from low fluid level sensors.
- Activated warranty claims for the system manufacturer.
- The need to replace heat transfer fluids, which might be difficult to obtain quickly.

In most facilities, a combination of the users' tolerance for leaks and the size of the budget will dictate the style of pump needed. Plants in higher technology industries typically cannot tolerate any leaks, and government regulations or a company's own fugitive emissions limitations might also demand a leak-free system. Though many of the heat transfer fluids used in chillers vaporize quickly and are nontoxic, users still tend to want to avoid leaks as that could be considered a system design flaw.

Sealless Pump Designs

Two common varieties of sealless pumps are magnetically coupled and canned motor.

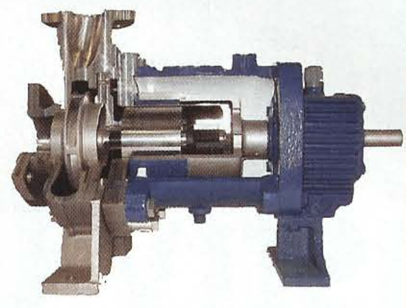
The magnetically coupled type, also commonly referred to as "mag-drive," uses a system of two magnets separated by a fluid barrier or containment shell. The outer magnet is affixed to the motor shaft while the inner magnet is attached to the pumping mechanism (gear, impeller, vanes, etc.). The two magnets are coupled together with the fluid barrier in between, allowing the motor to drive the pumping mechanism without a shaft seal.

Canned motor models use a special motor that is designed to allow the pumped fluid to circulate within it. The motor is hermetically sealed to avoid any fluid leaks, and there is typically a seal between the pump casing and the motor. The motor shaft is entirely immersed in the fluid, thus avoiding the need for a shaft seal.

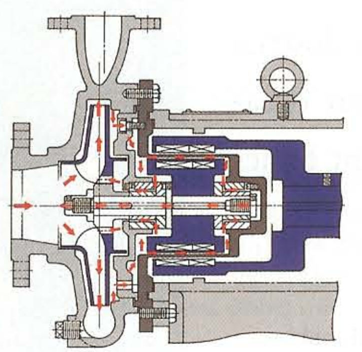
Selecting the Right Sealless Pump

Using a sealless pump does not ensure a lack of leaks, nor does it ensure reliability. Engineers must still be diligent in selecting the right pump for the application. Following are some considerations for selecting the right sealless pump:

- On mag-drive pumps, the magnets should be designed for the temperature range in which the pump will be used. For example, samarium cobalt is better than neodymium for higher temperatures.
- On canned pumps, the motor internals, including windings, should be designed for the operating temperature range.
- Operations in which the pump will be subjected to extreme low or high temperatures should consider choosing a design with non-conductive thermal barriers between the pump and motor coupling to minimize the amount of heat conducted along the coupling and prevent bearing failures.
- Any materials that will come into contact with the fluid should be chemically compatible with the fluid. The pump also should be resistant to wear caused by entrained particulates. Metallic components are not always more wear-resistant than nonmetallic components; ceramic materials such as silicon carbide can withstand much higher levels of wear.
- Seals and gaskets should be rated for the operating temperature range and fluid.
- Material tolerances should allow for expansion and contraction over the operating temperature range.
- The pump should be designed to handle rapid fluid degassing at the suction port and be able to disperse vapor without losing prime.
- A sealless pump's small internal passageways can be easily clogged by debris and cause failures; therefore, sealless pumps are not designed to pump slurries or other solids-laden materials.



A magnetically coupled pump uses a system of two magnets separated by a fluid barrier or containment shell.



In this illustration of the flow path through a magnetically driven pump, smaller arrows illustrate the liquid lubricating and cooling the pump bearings.

All images courtesy of Magnatex Pumps Inc.

- Lined pumps may not be suitable for all heat transfer fluids. Some fluids have a tendency to permeate the material and can delaminate the lining when they get behind the nonmetallic material. These fluids also can cause the lining materials to swell dramatically.

Maintenance Considerations

Although sealless pumps can significantly minimize maintenance requirements, some maintenance is still required to optimize the system's uptime. For example, motor bearings might require regular lubrication if they are not permanently lubricated. The torque on casing bolts should also be checked, especially if the fluid temperature changes frequently or rapidly. Additionally, the pumping mechanism (gear, impeller, vanes, etc.) may wear over time, requiring occasional replacement. Typically, magnetically driven designs are easy to repair onsite when the need arises. Repairs of canned motor pumps usually must be handled at a specialized service center. With smaller units, replacing the pump can be a more cost-effective solution.

A common problem with pumps in chillers is reduced flow or pressure. This typically is caused by excessive restriction in the pump suction line, often at the suction strainer. Strainers prevent larger particles and debris from entering the pump; however, they can become clogged for a number of reasons. For example, substantial debris can be created during system construction. This debris should be eliminated prior to starting the system, but it is a common culprit in strainer clogs. In some operations, the growth of microorganisms can generate large volumes of solid material, while in others, the process itself generates particulate and debris. Additionally, thermal degradation or chemical reactions between the pump materials and the fluid can cause the fluid viscosity to increase dramatically, in some cases precipitating solids that can clog the system. Pump strainers should be checked regularly and cleaned to prevent cavitation, which can reduce pump life and system reliability.

With minor preventive maintenance, sealless pumps can provide a significant payback over the life of the system. Some sealless pumps have been known to operate for 15 years or more without requiring maintenance. **PCE**

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