Run Times
LAWRENCE PUMPS INC.
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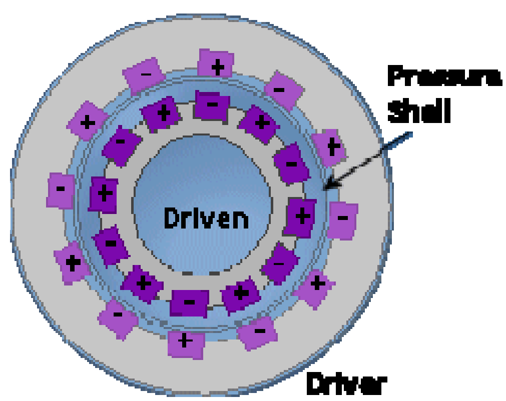
For many applications that deal with hazardous liquids, a significant part of the centrifugal pump selection process involves the choice of a safe and reliable sealing method. There are two pump design approaches that prevent process leakage to atmosphere: mechanical shaft seals and hermetically sealed pumps. The advantage of most hermetically sealed pumps is that there are no mechanical seals to fail and, barring a catastrophic failure, there is no leak path to atmosphere when pumps do fail. This issue provides a basic overview of some basic features of hermetically sealed pumps. It is not meant to describe the limits of the technology available, but instead describes the most common representations found in the industrial pump marketplace.

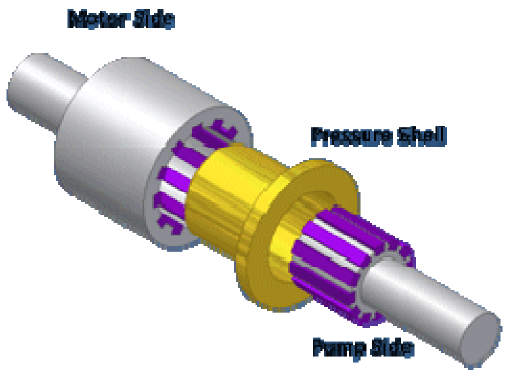
Hermetically sealed pumps, often referred to as sealless, or glandless, pumps are characterized by a pump rotor supported by journal bearings where there is no shaft penetration of the pressure containment. The pressure containment encapsulation of the entire rotor not only precludes the need for mechanical shaft seals, but it also eliminates any suction pressure related axial thrust, making the units ideal for high suction pressure applications. Axial thrust management is accomplished through a combination of rotor design and the use of process lubricated thrust discs or, in some cases, hydrodynamic bearings. Hermetically sealed pumps fall into three categories: Magnetically coupled pumps, dry stator canned motor pumps, and wet stator canned motor pumps.

Magnetically coupled

Magnetically coupled pumps, also referred to as mag-drive pumps, incorporate powerful rare earth magnets mounted on a drive shaft that magnetically engage a secondary set of magnets on the driven shaft. The driver shaft and the driven shaft are separated by a thin non-magnetic shell that separates the process from atmosphere. The drive shaft is connected to a standard electric motor that engages the driven shaft in synchronized movement as a result of the magnetic coupling formed between the two sets of magnets.



The non-magnetic shell is often a corrosion resistant nickel based alloy, or a non-metallic composite or ceramic material. The non-metallic shells are more pressure or temperature limited than the metallic shells. The real advantage of non metallic shells is that they do not experience inductive eddy currents that are inherent to the metal shells. Eddy currents increase the temperature and reduce the available bhp. Pumps with non-metallic shells are more efficient than metallic shell units.

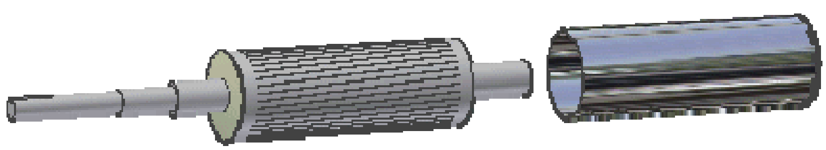


Magnetic Coupling

One concern often voiced with a magnetically coupled pump is that the single pressure shell (or single containment) that separates the rotor and stator magnets is very thin and runs in close proximity to the rotor magnets. It is possible in some failures for the pump rotor to come in contact with, and breach, the single pressure shell, resulting in a process release to atmosphere. To provide a secondary containment some manufactures add mechanical sealing on the motor drive shaft.

Manufactures claim that magnetic couplings are available for applications requiring over 400 kW (540 bhp), and for temperatures over 400^0C (750^oF). It should be expected that these limits would be for highly engineered pumps and not for standard designs. High temperature and high horsepower are also somewhat mutually exclusive. The effectiveness of the magnets decreases as the temperature increases, limiting the power available at elevated temperatures. Additionally, large magnet assemblies pose the additional problem that they are tough to pull apart and can be dangerous to put back together. Safe maintenance of large high strength magnetic assemblies is a job that requires care and training.

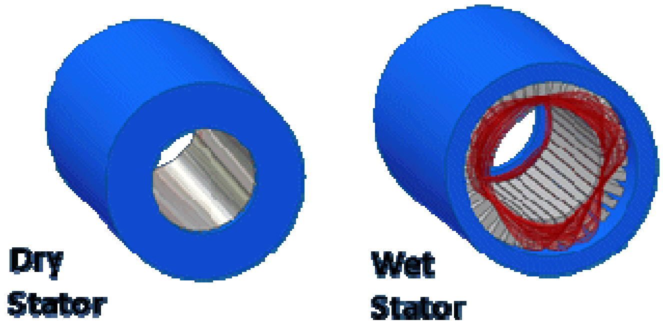
Canned Motor Pumps



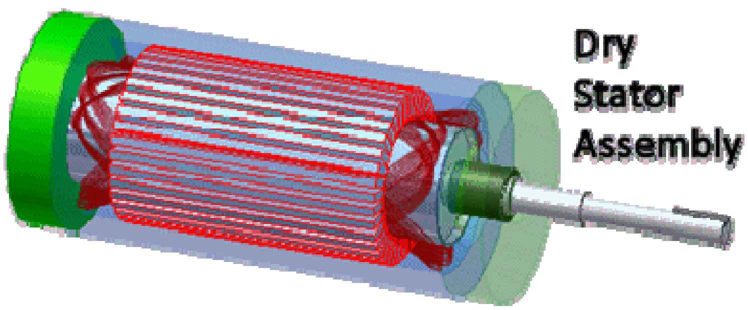
Rotor

Canned-motor-pumps integrate the pump motor within the pressure containment housing such that there is not only no shaft penetration, but there is also no separately coupled motor. In a canned motor pump, the motor rotor is a part of the pump rotor assembly. The motor rotor is encapsulated by a thin non-magnetic housing, or can, to protect it from the process fluid. The motor stator is also within the pump pressure containment housing and may be either a wet or dry design.

In a dry stator design the stator windings are isolated from the process fluid by a thin non-magnetic sleeve mounted in the bore of the stator/pressure housing assembly such that the stator windings are completely Isolated from the process fluid. This internal sleeve, or can, is what forms the basis of the frequently used term “dual-containment” describing dry stator canned motor pumps. The sleeve forms a liquid tight pressure containment barrier that prevents process fluid from entering the stator cavity, and the outer housing of the pump forms a second pressure containment. If the can is breached due to rotor contact the stator will fail but pressure is contained by the outer pressure shell.



In a wet-stator design each motor winding is encapsulated in a polymer sheath that is exposed to the process fluid during pump operation. Wet stator units have a heat removal advantage over dry stator units because the fluid circulates in direct contact with the windings. Wet stator designs also have a higher volume of fluid in the motor section for a given power rating than a dry stator design and exhibit a lower rate of temperature rise. Similar to a magnetically coupled pump, the rotor runs in close proximity to the stator in a wet stator motor. In some failure modes the rotor will also contact the stator windings which invariably results in unit failure due to damage to the stator windings. The wet stator motor is also a single containment motor, but the pressure containment housing is separated from the rotor by the stator and is unlikely to breach during a motor failure.



Probably the biggest disadvantage of the canned motor pump relative to the magnetically coupled pump is that the motor is designed into the pump and not a stock motor. In some cases pump failure also becomes a motor failure. This combination of mechanical and electrical failure demands the expertise of two separate crafts to institute a repair which is often outside of the capabilities of in-house repair personnel.

Manufactures claim that canned motor pumps are available for applications over 1200 kW (1600 bhp) and for temperatures over 400^0C (750^oF). Similar to magnetically coupled pumps, these ratings are for engineered product. A few manufacturers offer high temperature designs as a standard product but selection seems to be limited to smaller pump sizes.

Sealless pumps have operational limitations, and those limitations are all too frequently the cause of many reliability problems. In our next issue we will cover some of the more common problems encountered in the application of sealless pumps.