Ross MACKAY Associates Ltd.

Mechanical Seal Selection Basics

by ***Ross Mackay***

Once referred to as the “black box” inside a pump that no-one really understands, the mechanical seal is that other part of the process pump that is constantly failing. To help alleviate that unworthy accolade we must understand the most important aspects of the mechanical seal.

One of the most important things to remember about mechanical seals is that they are purchased by two different types of customer. While they both share a desire to ensure that the seal "works", the two groups tend to have different priorities when selecting a seal.

The end user generally considers reliability, ease of installation, availability, flexibility, and other factors important to the long term operation of the whole plant. On the other hand, the majority of pumps are purchased on the basis of "low bid" and the pump supplier is constrained by that short term budget

This means that the end user must know which seal is needed for the particular application as indicated below. It also requires a knowledge of the important aspects of mechanical seals and their operation as part of the pump.

Basic Operation

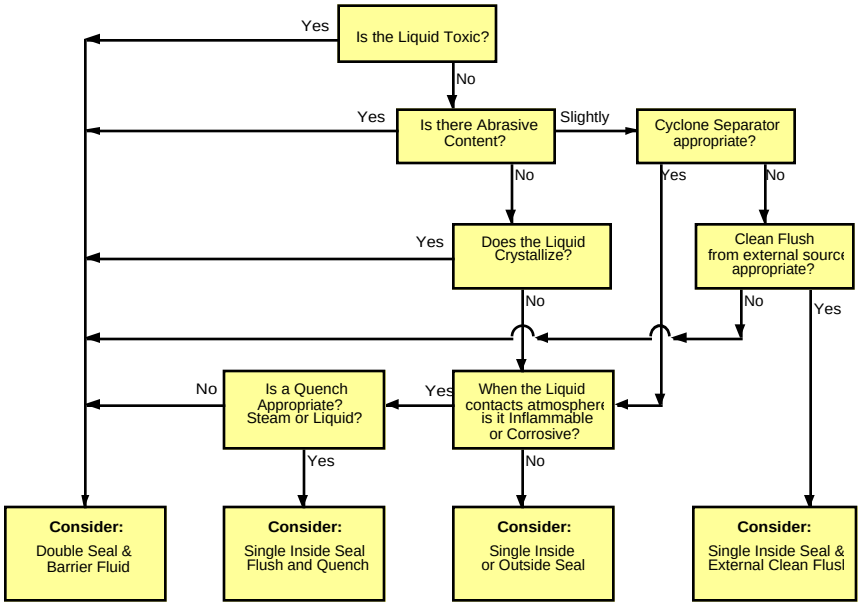
A mechanical seal operates by having two flat faces running against each other. The rotating face is secured to the pump shaft while the stationary face is held in the gland. This is the first of the four possible leak paths that must be secured. The others are shown in Figure 2, and are,

between the Rotating Face and the Shaft,
between the Stationary Face and the Gland, and
between the Gland and the Stuffing Box.

The last two are jointly referred to as the “Tertiary Seal”, and each one comprises a fairly simple sealing challenge as there is no relative motion between the two parts involved.

The Seal Faces

For many years, the most popular combination of seal face material was the carbon rotating face running on a ceramic stationary. These are still in popular use, and have been augmented by stainless steel, tungsten carbide and silicon carbide.



As the seal faces are machined to a high degree of flatness accuracy, very careful handling of these faces is essential during installation. The seal manufacturers' installation instructions must also be carefully followed to ensure that the seal faces are suitably protected and precisely located.

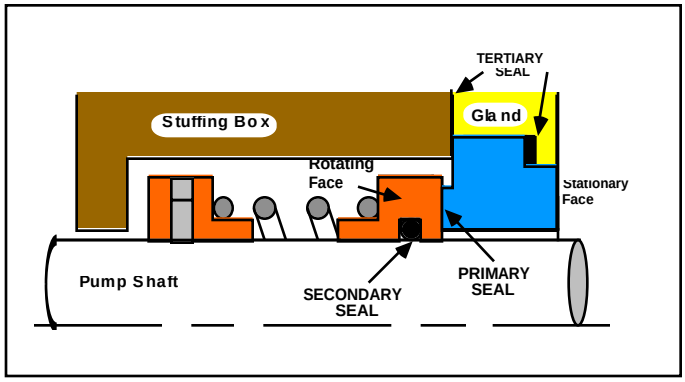


Figure 2

Seal Flexibility Options

Any axial or radial movement of the shaft, will require some flexibility from the spring(s) in order to keep the faces closed. This flexibility however can only be carried to a certain degree, and the mechanical condition of the pump plays an important role in the reliability of the seal.

This seal flexibility is usually supplied by a single large spring, a series of small springs, or a bellows arrangement.

In traditional seal designs the springs were applied to the rotating face, but more recent designs apply the springs or bellows to the stationary face of the seal. In fact, it is now quite common to find both stationary and rotating faces of a mechanical seal having some kind of flexible mounting arrangement.

Although the main closing force is normally provided by the pressure in the stuffing box, the springs and bellows compensate for any shaft movement and keep the seal faces closed during startup and shutdown of the pump.

Balanced or Unbalanced Seals

An Unbalanced Seal exposes the full cross-sectional area of the rear of the rotating face to the stuffing box pressure and creates a relatively high closing force between the seal faces. Balancing a mechanical seal reduces the closing force which tends to lower wear rate and the temperature buildup, thus extending the life of the seal.

While the balanced seal may appear to be the answer to all sealing problems, certain services may be better served with the unbalanced seal, depending on the need. For example, some light slurry applications may need the additional security of the higher closing force at the seal faces.

Regardless of any other consideration, a balanced seal is usually recommended when the stuffing box pressure exceeds 50 p.s.i.

Inside or Outside Seals

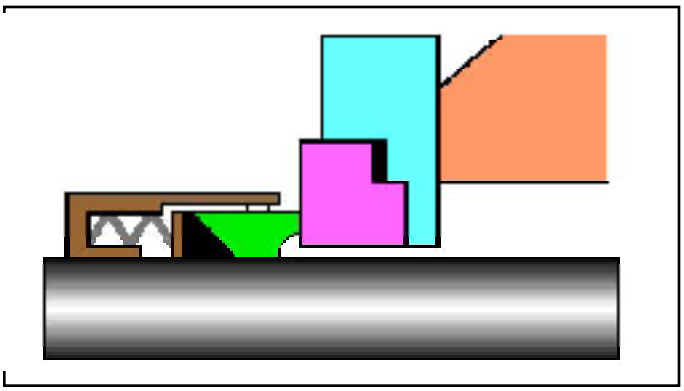


Figure 3

The more popular arrangement positions the seal inside the stuffing box. Although this requires disassembly of the pump wet end to carry out any maintenance on the seal, the main advantage is that it is possible to control the seal environment inside the stuffing box.

An Outside Seal reverses the orientation of the stationary face as shown above and locates the rotating unit on the shaft outside the stuffing box gland. This simplifies installation and saves maintenance manhours.

An important addition to the Outside Seal in recent years is the Split Seal that eliminates the need to dismantle the pump every time the seal needs to be changed.

Component or Cartridge Seals

A component seal is one where each part of the seal must be assembled on the pump individually. This requires considerable skill and significant time investment on behalf of the maintenance department.

The cartridge seal is a completely self-contained assembly which includes all the components of the seal, the gland and the sleeve in one unit.

As it does not require any critical installation measurements, it simplifies the seal installation procedures while simultaneously protecting the faces from accidental damage. It also effectively reduces the time spent on maintenance by simplifying seal installation and change-out procedures.

Single or Double Seals

A Double Seal is used instead of a Single Seal when a high degree of leakage protection is desired. It comprises two sets of seal faces combining to increase the security of the environment from the pumpage. They are most frequently used for volatile, toxic, carcinogenic, hazardous and poor lubricating liquids.

Every double seal requires a barrier fluid between the two sets of seal faces and ensure that the outer set of faces receive some lubrication. The recent introduction of Gas Seals uses an inert gas between the seal faces which eliminates any possibility of product contamination.

CONCLUSION

When the mechanical seal is properly selected and correctly installed and supported, all it needs is the protection of appropriate environmental controls to provide extensive and reliable service.