Mechanical seals explained

The basics

Mechanical seals are leakage control devices, which are found on rotating equipment such as pumps and mixers to prevent the leakage of liquids and gases from escaping into the environment. Figure 1 shows a typical centrifugal pump, which highlights its constituent parts, including the mechanical seal.

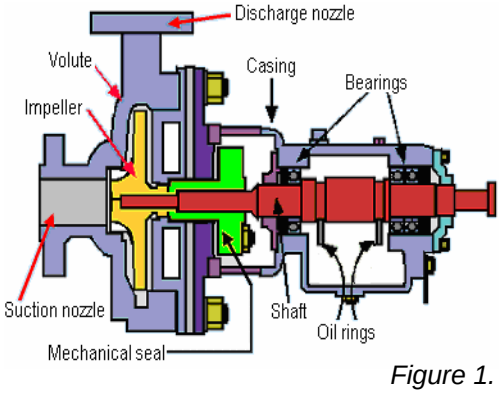

Figure 1.

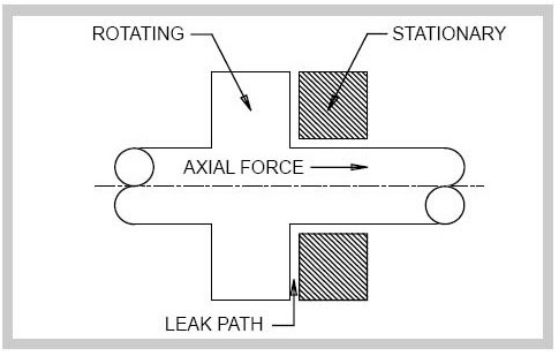

Figure 2.

A mechanical seal consists of 2 principle components. One component is stationary and the other rotates against it to achieve a 'seal' (Figure 2). There are many types of mechanical seal, ranging from simple single spring designs to considerably more complex cartridge seal types. The design, arrangement and materials of construction are essentially determined by the pressure, temperature, speed of rotation and product being sealed (the product media).

Design

By way of example, a simple mechanical seal design has 7 components (Figure 3):

1. Stationary component; commonly referred to as 'the seat'.
2. Stationary component sealing member.
3. Rotating component.
4. Rotating component sealing member.
5. Spring.
6. Gland plate.
7. Clamp ring.

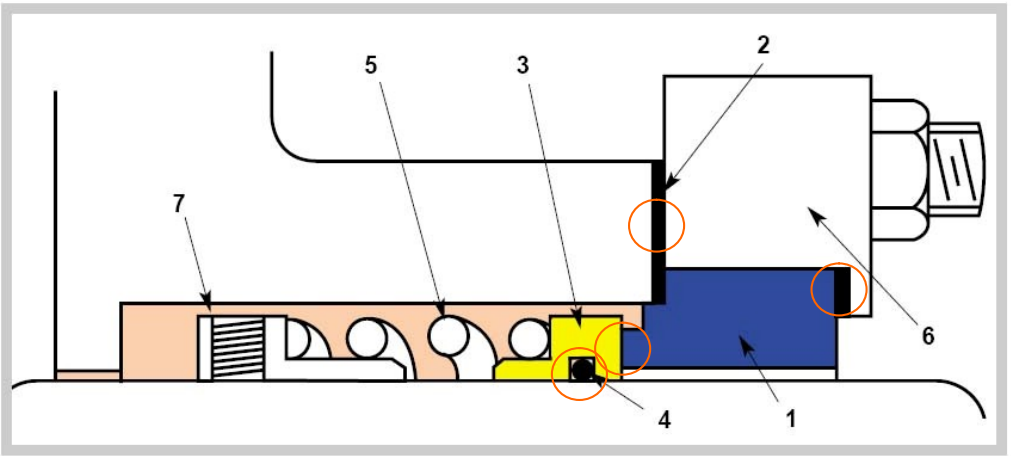

Figure 3.

A mechanical seal has 4 main sealing points (indicated by orange circles as per Figure 3):

I. The seal between the rotating (3) and stationary faces (1). This is known as the **primary seal**.
II. The seal between the stationary member (1) and stuffing box face, i.e. Gasket (2).
III. The seal between the rotating member and shaft or shaft sleeve (4). This is known as the **secondary seal** and may be an 'o'-ring as shown, a 'v'-ring, a 'wedge' or any similar sealing ring.
IV. The seal between the gland plate and stuffing box, this is usually a gasket, or 'o'-ring.

Sealing points

3 of the 4 main sealing points need little explanation, but consideration is required for the sealing point between the rotating and stationary components (**faces**). This primary seal is the basis of a mechanical seal design, and is what makes it work.

The rotating component (3) and stationary component (1) are pressed against each other, usually by means of spring force. The mating faces of both components are precision machined (lapped) to be extremely flat (usually to within 2 light bands, which is an optical method of measuring flatness). This flatness minimizes leakage to a degree where it is essentially negligible. In fact, there is leakage between these faces but it is minute and (for immediate consideration) appears as a vapour.

Spring compression (usually) provides initial face pressure. This pressure is maintained when the seal is at rest via the spring(s) thus preventing leakage between the faces.

Fluid film

If the mechanical seal faces rotated against each other without some form of lubrication they would wear out (and the seal would fail) due to face friction and the resultant heat generated. So, lubrication is required which for simplicity, is supplied by the product media. This is known as **fluid film** and maintaining its stability is of prime importance if the seal is to provide satisfactory and reliable service.