TECH TIP

# Types of Pump Seal Failure

**What are Pump Seals and what do they do?** In most pumps, there is an impeller or a pumping element that rotates on a shaft. The shaft, however, must pass through the pump casing. This intersection point creates an area where possible leakage may occur. That's where pump seals come in. Pump seals prevent the leakage of process fluids inside a pump by creating a barrier between the moving parts and the stationary parts of the pump. (See figure 1)

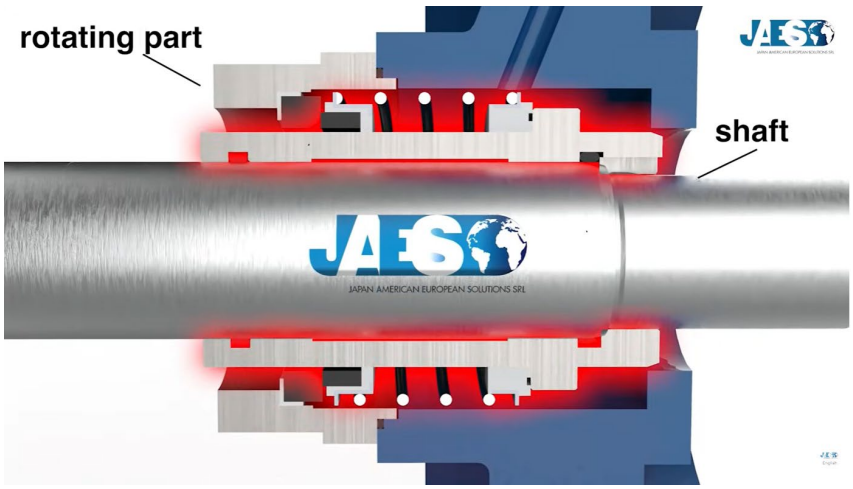


**Figure 1: Pump Mechanical Seal**

**What are some Common Causes of Pump Seal Failure?** Pump seal failure usually happens when mechanical seal faces are damaged, separated, or overheated, allowing process fluid to leak along the shaft. These are some common causes:

- **Blocked Suction of the Pump** – This could cause the pump to run dry and eliminate the thin liquid film lubricating the mechanical seal faces. Without it, the increased friction would create rapid heat buildup resulting in cracking or warping. Additionally, blocked suction of the pump may also lead to cavitation. This is when the pressure in the liquid drops below its vapor pressure leading to rapid vapor bubble formation and collapsing, vibration, and seal misalignment.
- **Abrasive or dirty Fluids** – If the fluid contains solids or particles, the mechanical seal faces can become scratched and form a leakage path.
- **Blocked discharge of the Pump** – This could cause pressure to build up in the pump casing resulting in the seals blowing out

## Calculating release rate during seal failure:

$$Q = \frac{\pi \cdot h^3 \cdot \Delta P}{6 \cdot \eta \cdot \ln\left(\frac{r_2}{r_1}\right)} \quad \text{Equation 1}$$

Where:

Q = leakage rate in m3/sec (in3/sec)

$r_1$ = inner face radius in mm (in)

$r_2$ = outer face radius in mm (in)

h = gap height in µm (µin)

ΔP = pressure differential in Pa (psi)

η = dynamic viscosity of the sealed fluid in Pa·s (lbf-sec/in²)

**Equation 1: Leak rate from mechanical seal**

When evaluating the severity of a leak in a pump seal failure scenario, equation 1 can be used to calculate the release rate. Depending on the release rate, quantity released, type of chemical released, and external factors, the overall consequence and necessary safeguards may vary.

## How can you prevent/ mitigate pump seal failure?

- **Regular Inspection** – Regularly check for leaks around the seals and make sure the pump components remain aligned.
- **Dual Seals** – Instead of one seal, pumps can use double mechanical seals which will provide a secondary barrier if the primary seal fails and a buffer or barrier fluid to prevent product release.
- **Pump trips** – Pumps may be equipped with trips to shut down the system upon low suction pressure, high vibration, etc.
- **Emergency Isolation Valve (EIV)** – Upon detection of abnormal flow, EIVs block the flow path and isolate material preventing continued release.
- **Inherently Safer Design** – Some designs eliminate the possibility of seal leaks entirely such as the use of a magnetic drive pump/ magnetic impeller. These pumps have no shaft seal, so seal leakage cannot occur.

Sources:


Calculate the Leakage Rate of a Mechanical Seal | Pumps & Systems

Understanding Pump Seals: Types And Their Importance