Pump Seals

Introduction

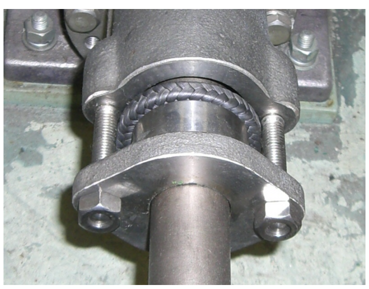
Often water treatment chemicals are blamed for leaking pump seals and generally this is not the case. The following information can be used to better understand how pump seals work and how problems with them can occur.

The primary function of a pump seal is to limit or prevent leakage of the process fluid from the pump housing and shaft to the environment. This is done by forcing a softer material surface up against a harder material surface to form a seal between the housing and shaft.

The space between these surfaces requires a fluid film for lubrication and heat rejection. This can be a "controlled" leakage of the process fluid being pumped or an external source liquid.

Pump Seals can be ***Packed Seals*** or ***Mechanical Seals:***

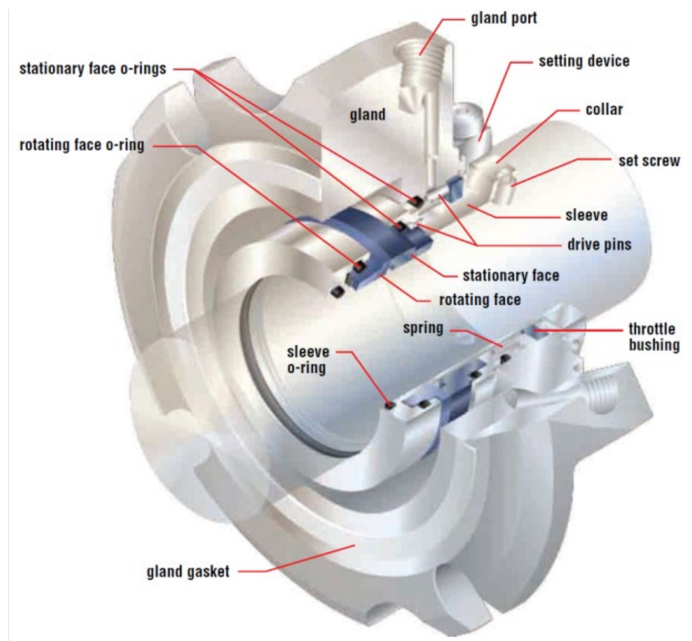
Packed Seals



Packed Seals use a soft woven lubricant infused yarn (the most common of which is graphite impregnated Teflon) pushed up against the pump shaft and pump housing by a bolt tightened gland follower. A small amount of liquid is allowed to leak through this assembly to provide a fluid film for lubrication and heat rejection. A rule of thumb is that 10 to 50 milliliters a minute per inch of shaft length is usually sufficient for this purpose.

Common Pump Packing Materials	
PTFE Graphite • pH: 0-14 • Temperature: 550 F • Pressure: 300 psi • Speed: 4000 fpm	Flexible Graphite • pH: 0-14 • Temperature: 1250 F • Pressure: 3600 psi • Speed: 4000 fpm
PTFE Fiber • pH: 0-14 • Temperature: 500 F • Pressure: 1000 psi • Speed: 3000 fpm	Amarid Fiber • pH: 3-11 • Temperature: 500 F • Pressure: 500 psi • Speed: 1900 fpm

Mechanical Seals



Mechanical Seals use a spring or a bellows to push together the face of a hard material against the face of a soft material to form a seal between the pump housing and shaft. There still needs to be a small "controlled" amount of liquid to leak through this assembly to provide a fluid film for lubrication and heat rejection.

Hard Seal Face Materials	
Reaction Bonded Silicon Carbide	General duty hard face material, excellent physical properties, cannot be used in caustics and/or aggressive acids.
Sintered Silicon Carbide	General and chemical duty hard face material, excellent physical properties, used in aggressive chemical applications.
Alumina Oxide (Ceramic)	Chemical duty hard face material, excellent chemical resistance, limited to low duty service.
Nickel Bound Tungsten Carbide	General duty hard face material, excellent physical properties, impact resistant, limited use in aggressive chemicals.

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Mechanical Seals can come pre-built as a “cartridge” seal or in parts as a “component” seal. A significant issue with the successful operating life of a *mechanical seal* is how it is installed. A pre-built cartridge seal minimizes the concern of proper installation.

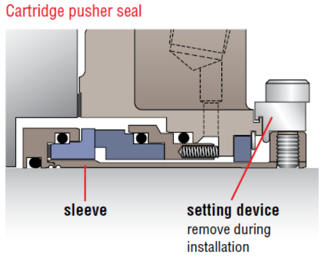
Soft Seal Face Materials	
Resin Impregnated Carbon	General duty soft face material, good chemical resistance, good frictional properties.
Metallized Carbon	Antimony metal filled carbon, high duty soft face material, limited chemical resistance, good physical properties, blister resistant.

The most common type of *mechanical seals* is the “pusher” type. This seal uses a spring to push the faces of the seal together. Usually, because of the uneven pressure applied by the spring to all parts of each of the faces, this type of seal is “unbalanced” requiring a higher pressure to form the seal.

Another way to push the faces of the seal together is by using a metal bellows. Below is shown the “bellows” type. The pressure around the faces of the seal is more even. This type of seal is referred to as “balanced” and wears more evenly and lasts longer than a pusher type. It is also more expensive.

Cartridge Seals

Cartridge seals are self-contained *mechanical seals* consisting of a shaft sleeve, seal, and gland plate. The unit is fitted onto the pump shaft as a built assembly, and no further fitting is required. *Cartridge seals* are an attempt to overcome the fitting problems of conventional seals.



O-Rings

Mechanical Seals contain O-rings made of elastomers that separate the pumped liquid from the metal components of the seal. The chart below shows the elastomer compatibility for the fluid in contact with these seal components.

	Elastomer Compatibility			
	A - Excellent	B - Good	C - Poor	D - Not Recommended
	Viton FKM	Chemraz FFKM	Buna-N NBR	EPDM
Amines	D	A	D	B
Anionic Surfactants	A	A	A	D
Beer	A	A	A	A
Borate	A	A	A	A
Chlorine Dioxide	B	B	D	C
Ethylene glycol	A	A	A	A
Propylene Glycol	A	A	A	A
Silicate	A	A	A	A
Sodium Hydroxide 20%	B	A	B	A
Sodium Hypochlorite 2.5%	A	A	B	B
Water	A	A	A	A

National Association of Corrosion Engineers (NACE)

The NACE Unit Committee T-7A on Cooling Waters prepared a white paper on causes of *mechanical seal* failures in cooling and heating system pumps. This committee reported the four major causes of premature seal failures to be:

1. Improper installation of seal or pump.
2. Operating dry or partially dry.
3. Suspended solids in circulating water.
4. Excessively high water temperature.

The NACE Task Group T-7 G-1 also set up and performed a controlled scientific study on the effects of common corrosion inhibiting treatment components on *mechanical seals* in hot water recirculating systems. Their findings were that standard Nitrite/Borate/Azole Corrosion Inhibitor Programs up to 4,000 ppm as NO2 have no effect on *mechanical seal* life.

References

NACE, "Causes of Failure of Rotary Shaft Seals in Cooling and Heating System Pumps.", NACE Publication 7A170, 1970, reaffirmed 1981.

NACE, “Investigation of the Effects of Corrosion Inhibiting Treatments on Mechanical Seals in Recirculating Hot Water Systems”, NACE Publication 7G181, 1981, reaffirmed 1997.

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