

TECHNICAL INFORMATION: MECHANICAL SEAL PERFORMANCE

At CIRCOR, we focus on delivering the best overall value and lowest total cost of ownership for our customers. We are proud to deliver performance-based products that decrease maintenance, boost efficiency, increase intervals between service and reduce energy costs.

We design our products to be of “heavy duty – industrial grade” construction. Certain models are specifically designed for “severe duty” service, such as in marine, navy, industrial process or power generation applications.

MECHANICAL SEALS

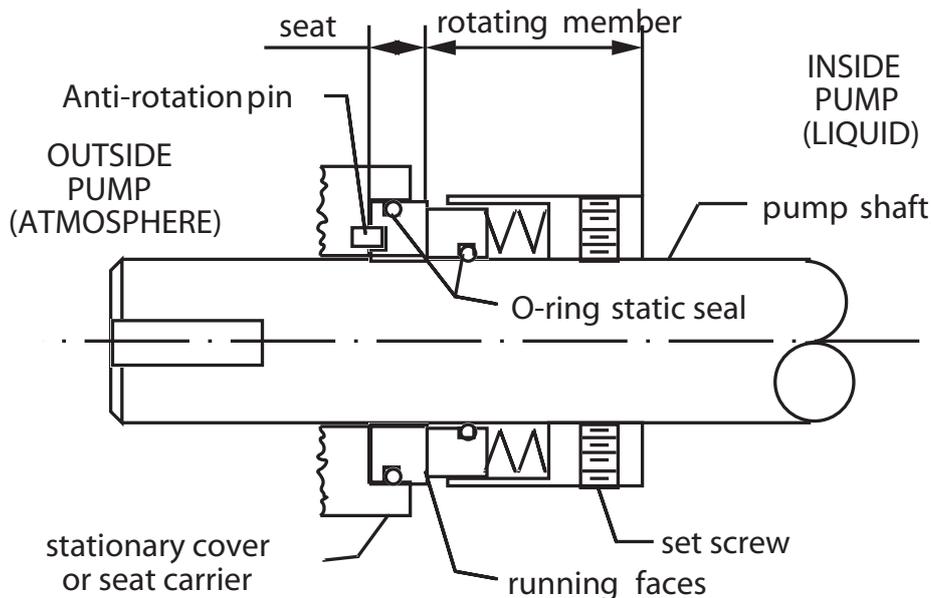
The amount of acceptable leakage, if any at all, is a controversial subject for which there are few clear answers. This document is intended to clarify what to expect on mechanical seals found in ALLWEILER® and IMO® AB pump products.

DESIGN

A mechanical seal figure 1, consists of a stationary member, seat, and a rotating member. The rotating member is statically (or nearly so), sealed to and rotates with the pump shaft. The seat is statically sealed to a nonmoving cover. The rotating member has a seal ring, with a highly polished and a very flat face which runs against the seat face, also a very flat and highly polished surface. Primary sealing takes place where the rotating and stationary faces are in near contact.

The force which maintains contact between the faces is provided by a spring, frequently supported by additional pressure load. The seal faces cannot be permitted to run dry (in hard contact) as the frictional heat build-up will very quickly cause severe seal face damage and extensive leakage. Because the faces cannot run dry, they are designed to allow a very thin film of liquid to exist between and migrate across the seal faces. In a properly operating mechanical seal, this thin liquid film, of necessity, leaks to the low pressure side of the seal, usually outside the pump.

In a single type mechanical seal pump, this liquid is normally the fluid being handled by the pump. There are more complex designs with double, tandem or other arrangements which place a barrier fluid between seals such that one of the seals is exposed only to the barrier fluid while the inner seal also is exposed to the liquid being pumped.



LEAKAGE

Many pumped liquids are sufficiently volatile that the frictional heat gained while traversing the seal face, causes the leakage to vaporize. Such fluids may display no apparent or visible leakage. Leakage is, however, still taking place. Other liquids will not so readily vaporize and thus may show an accumulation of leaked liquid outside the pump. Liquid to be sealed, sealing pressure, face loading, speed, size, sealing face materials, finishes, temperature, viscosity, vapour pressure, normal tolerance variations and other parameters all impact how much apparent leakage will be incurred. Some seal manufacturers design seals for high face loads that minimize leakage but also shortens the seal life. Others use lightly loaded faces for long life but these seals are prone to greater leakage, figure 2.

THE MAIN POINT TO BE UNDERSTOOD IS THAT ALL MECHANICAL SEALS MUST LEAK TO OPERATE PROPERLY. MECHANICAL SEALS ARE CONTROLLED LEAKAGE DEVICES, NOT ZERO LEAKAGE DEVICES.

This is not what anyone wants to hear but that is the current state-of-the-art in single mechanical seals. The amount and cosmetic visibility of the leakage will vary from pump to pump. A leakage rate of 10 drops per hour or less per seal is considered an acceptable leak rate for mechanical seal pumps manufactured in our North American or European facilities. Many if not most pumps will operate well below these limits but up to these limits, we will not consider the seal operation improper. Note that seals will sometimes "run in" and leakage will gradually diminish over several hours operation with new seals. Disturbing (separating) seal faces may cause it to leak slightly more than before being disturbed since the faces will not be "tracking" in exactly the same manner. These, too, may wear back in and cease or nearly cease apparent leakage.

STARTUPS

Startups can be particularly hard on mechanical seals. Insure that the pump seal chamber is filled with appropriate liquid so the seal does not start dry. Otherwise, initial dry start damage will progress to a severe leak. Dirt and other fines will also deteriorate the surface finish of the mechanical seal faces resulting in premature leakage. The most common mechanical seal face material combination is carbon against a nickel-iron (Ni-Resist). Very hard face materials such as tungsten carbide, silicon carbide and others are also available to better resist abrasive wear albeit at higher initial cost.

Hard-on-hard face combinations, such as silicon carbide on tungsten carbide, are very susceptible to heat checking (formation of surface cracks) if allowed to run dry for even a few seconds.

CARBONISATION

Another factor that may cause increased leakage from mechanical shaft seals is carbonisation. This phenomena will appear in systems handling heavy fuel oil at temperatures above 60 - 70°C. The unavoidable small leakage, often creates carbon deposits in the seal area on the atmospheric side which deteriorate the seal performance. The degree of carbonisation varies with the fuel oil quality and temperature and will in due time cause hang up of the seal and completely block the seal area.

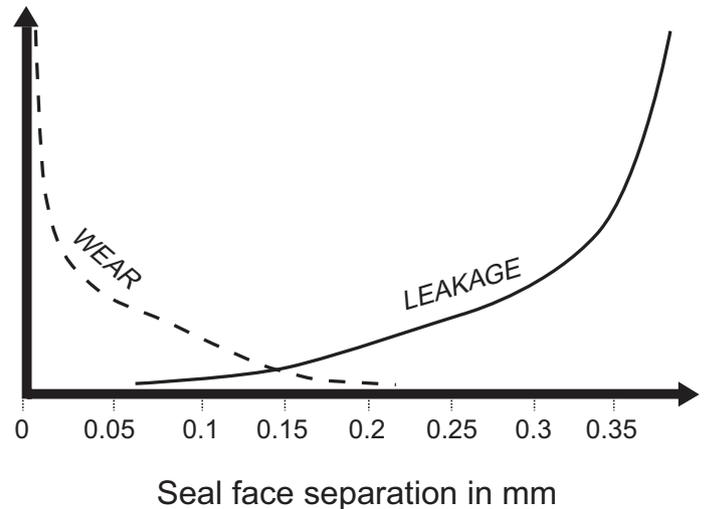


FIGURE 2: Leakage and wear rate vs face separation

Seal systems with liquid or gas barriers can minimize detectable leakage at significant increase in expense. Beyond that solution, there are sealless pumps such as canned or magnetically driven designs which can also be quite expensive but totally leak free. If the leakage is not an immediate health hazard, some systems, such as lubricating oil packages, can use vertically mounted pumps located inside the oil reservoir. Properly designed, these pump arrangements need not have shaft seals and flow that would normally cool and lubricate the seal is simply allowed to exit the pump and run directly back to the reservoir.



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