

MECHANICAL SEAL INSTALLATION AND SEAL RELIABILITY

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To obtain maximum seal life, the system and the pump itself have to be right. A pump which cavitates, has high vibration, or is in need of an overhaul rather than a seal change is not going to provide the seal's design life of over three years' continuous service. Modern mechanical seal designs can be extremely cost effective and reliable when installed on properly designed and maintained equipment. This brief article cannot hope to go into all of the conditions that must be considered to attain a minimal three-year service life; the hope of the authors is simply to correct some of the most common problems with the installation of a seal.

Mechanical seals are precision devices, with faces lapped within one-micron flatness. These seals can be very costly, and the installation procedure can determine how much of the dollar value spent is actually realized by any plant. With the increase in MULTI-craft personnel doing these installations, correct procedures become even more important to obtain long reliability and value. Poor installation, even with the newer cartridge seal designs, is still one of the major causes of failure and short seal life. For component and the new split seal designs, poor installation can account for up to 25% of the seal failures encountered!

INSTALLATION INSTRUCTIONS

Installation instructions contain a wealth of information. Make sure you read the instructions before installing the seal and save the instructions for future reference; you will be glad to have them should a problem crop up. In addition to telling you how to install the seal, they will typically include:

Assembly/disassembly procedures to follow when repairing a seal or when changing o-rings.

Dimensional data which should be checked prior to installation to make sure that the seal will fit in the equipment before everything is torn apart.

Operating limits which spell out the pressure, speed and temperature parameters within which the seal can operate.

The old mechanical seal may need to be disassembled to determine the cause of failure, unless the causes are obvious. A few minutes taken here can dramatically improve the life of the next installation. The old seal may be of the generation which can be "field repaired" with the correct repair kit. New seals may require installation of another O-ring compound, based on the failure analysis.

Proper elastomer choice is essential to seal operation. Temperature limits and chemical compatibility must be checked. Charts are available from seal and O-ring manufacturers. The O-ring selected must be correct for both the product(s) being sealed and any cleaners used to flush the system! O-ring lubrication is necessary for proper assembly. Check the compatibility of the lubricant with the elastomer compound and with the product.

Common lubricants are:

- Petroleum jelly (be careful NOT to use with Ethylene Propylene!)
- Silicon grease, which can be used on most O-rings
- Glycerin is sometimes used if there is a need for the elastomer to vulcanize to another part when it is used as a drive mechanism.
- Water
- Special lubricant (e.g. Krytox*) for compatibility with the product pumped.
- Zinc Oxide for salt water/brine services (to avoid Galvanic Corrosion)

O-ring damage can easily occur. Slicing is a common problem especially when the O-ring is compressed in its groove and is sliding over holes, snap-ring grooves, key-ways, slots or threads. Make sure all surfaces are properly de-burred (they should feel smooth to the touch). Sometimes it is possible to cover them with thin tape to ease installation. Be certain that the O-rings are in their proper position. Make sure the O-ring is in its groove or counterbore; some seal designs have many "steps", and the O-ring location may not be obvious. Refer to the installation instructions you saved, and check the drawings or photographs. For stuffing box face O-ring gaskets, commonly in the seal gland, grease can be used to keep the O-ring in place.

The surface finish on which the secondary seal or O-ring must seal is very important. For a static surface (where there is no relative movement) a maximum of a 45 RMS finish can be used. For dynamic surfaces, as on the balance diameter, a maximum of 32 RMS should be present, and in applications where there is substantial axial movement, a finish of 16 RMS is preferable. The harder the seal (e.g. spring energized Teflon* seals), the lower the finish requirement. Again, be sure that the surface is free from defects such as scratches, nicks, and burrs.

Teflon or Teflon encapsulated O-rings are stiff and easily damaged. Placing these O-rings in hot water will soften them up and facilitate installation; lubricate them well. For spring energized Teflon seals, check their orientation, as these are typically unidirectional seals.

Graphite secondary seals must be handled with care. They are fragile and easily damaged; O-rings can be twisted and stretched but graphite rings will break. One factor to carefully control is the compression of the rings. Very often the rings are compressed in arrangements that utilize screws. It is imperative that the loading be done uniformly to maintain the "squareness" to the shaft on rotary parts or parallelism to the gland on stationary parts. A torque wrench and a dial indicator should be used to maintain "squareness" and parallelism within the limits specified by the seal manufacturer.

When reassembling the seal, the instructions discuss at length a number of precautions to be observed; **READ AND FOLLOW THEM!!** Don't force components together; seal faces are easy to damage and expensive to replace! If you should damage a seal face or component, **STOP!** Don't install a seal that you are not confident will give full, satisfactory performance!

TESTING

Once the seal is assembled, you should test it. Dual seals are often tested with pressurized air and then submerged in water. Seals designed for liquids may let some small bubbles escape by the faces. Slowly rising bubbles between the faces are not a problem, as liquids will not leak under these circumstances. Bubbles coming from O-rings, through a casting, welding or a bellows are not acceptable. For face leakage you can rotate the seal by hand, and this will usually eliminate the leak. You may also put a few drops of water between the faces to verify the integrity of a liquid seal. Use distilled water, as tap water could leave mineral residues on the faces once it evaporates; this is particularly important if the seal will be stored for several weeks prior to installation.

INSTALLATION

Again, read the installation instructions first. Work on clean surfaces, with clean hands. Dirt and grime can destroy a seal face in a few revolutions. Make sure you take the time to do the installation at a relaxed pace. Do not hurry as this will often lead to tearing the equipment down again. Be careful handling the seal, particularly the faces. If you have dropped the seal, do not use it! Have the seal vendor check it out thoroughly, and have the vendor return it to the plant. If parts do not go together, don't force them! Measure, check drawings for orientation, and lubricate parts.

Don't over tighten; this is probably one of the most common mistakes. Never use a “leverage enhancement” method. Wrenches and hex keys are designed so that the average person will apply the proper amount of torque for a fastener of a given size. Two bolt glands can easily be distorted; this can, in turn, distort stationary seal components and result in face leakage. It can also damage the gasket, or cause extrusion, which may also result in leakage. Unfortunately, when leaks are encountered, the natural tendency is to keep tightening. Instead, try loosening; it often works! The preferred method is to use a torque wrench. Installation instructions give torque values for gland bolts, set screws, and socket head cap screws.

If you are not certain everything is correct, or that the seal doesn't feel right, it's never a bad idea to call the seal manufacturer or the sales representative for help **NOW!** The seal salesperson wants to assure your plant's success with his/her product. Calling them out two days later when the seal is leaking helps nobody involved.

AUXILIARY EQUIPMENT

Although not specifically part of a seal installation, auxiliary equipment installation and placement will have a significant impact on the performance of a seal. If the seal requires environmental controls, loss of these controls will almost certainly lead to premature seal failure. This leads to confusion at the time of failure analysis: the environmental controls get reinstalled

and the vendor does not get informed they were removed, causing the failure.

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The most common problems on double seal environmental controls relate to seal pots/barrier fluid reservoirs (also referred to as convection tanks). It is important to place them close to the seal, within 3-5 feet, and at least one foot above the seal. Use tubing that can be made to fit with large radii bends: small diameter piping with numerous elbows and a multitude of connections will compromise fluid flow and heat transfer. Keep the piping as simple as possible; the more complicated the piping to and from the seal, the poorer the flow of the barrier system. The closer to the seal the tank is, the better, so long as it is elevated a foot or so.

Another common "environmental control" is a flush, introducing a clean liquid into the seal gland or stuffing box to extend seal life. If installing a flush, be certain that the flush is at least 15 psi higher than the stuffing box pressure, and be certain the flush liquid is properly connected to the right flush port! Use a restriction bushing in the bottom of the stuffing box to make the flush effective. Most balanced seal designs do not require a large volume of flushing; 5-8 gallons per hour is normally all that is required for proper heat removal. Unbalanced seals will require substantially higher flows. Install some sort of flowmeter/rotometer to visually assure the flush is entering the seal area, and be certain that "Gremlins" can't turn off the flush supply!

* KRYTOX and TEFLON are DuPont's registered trademarks

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