SEALING SENSE

Q. *When and how do I use API Flush Plan 53?*

A. For a mechanical seal to perform effectively with optimum life it must be operated within design limits. Either the seal must be designed for the operating conditions in the rotating equipment or the environmental conditions surrounding the seal must be controlled within the seal's design limits. When seals and their environmental controls are properly designed, installed and maintained, the results are well worth the effort in terms of safety, emissions, process efficiency, reduced materials and labor and seal life.

Flush Plans for Seals

The environment around a mechanical seal may be controlled with an appropriate system to flush the seal with a suitable sealing fluid. While the flush plans described in detail in API and ASME publications are intended for centrifugal pumps in petroleum and chemical process service, they also can be used in other applications as indicated by design considerations.

Flush Plans for Dual Seals

Some services, such as toxic chemicals, hazardous products or materials that cannot be sealed with single seals, may require the use of dual seal sealing systems. Dual seals may be back-to-back, face-to-face or in series. These systems provide a clean external seal barrier fluid at a constant pressure greater then that of the product pressure on the inner seal. The barrier fluid should be compatible with the product. The flow may vary depending on the product temperature, seal size, speed, sealing fluid and dual seal design. The seal manufacturer can assist in heat load calculations and recommend an adequate flush rate to protect the seal. The sealing fluid outlet should be at the top of the seal chamber to prevent gas entrapment. The external source can be from a pressurized reservoir, whereby a small pumping device is often built into the seal assembly. A reliable supply of a compatible pressurized barrier fluid also can be used.

API Plan 53, also identified as ANSI Plan 7353, is a pressurized external fluid reservoir with forced circulation. The primary intent of this plan is to isolate the product being pumped from the atmosphere, thereby extending seal life by providing a favorable artificial environment for the seal (example: abrasive or non-lubricating liquids).

When this flush plan is utilized, the pressurized barrier fluid lubricates both the inner and outer seal faces. A very small amount of barrier fluid will migrate across the inboard seal faces and into the product. It is critical that the barrier fluid be maintained at a pressure 25 to 30 PSI above the seal chamber pressure. This will ensure that the barrier fluid, not the product being pumped, is lubricating the inboard faces.

Plan 53 guarantees virtually zero emissions to the atmosphere. The barrier fluid may become contaminated from mixing at the inner seal faces. This occurs if there is a pressure reversal and product pressure exceeds the seal pot pressure. For this reason, double balanced pusher seals are recommended, since they are much less susceptible to this mixing.

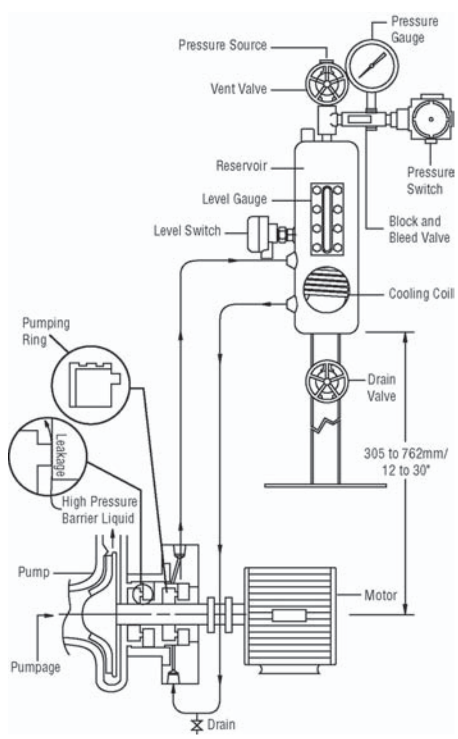

Figure 1. Plan 53 Dual Pressurized Barrier System

The forced circulation is preferred over thermal siphon. Cooling coils can be utilized in the reservoir to prevent flashing and to remove seal face generated heat.

Proper installation and maintenance is required to ensure optimum performance of Plan 53. Guidelines are as follows:

- Seal reservoir distance from the pump should be less than 4'.
- Distance from the pump shaft centerline to the bottom of the reservoir should be 12" to 18".
- Reservoir size is generally one gallon per inch of shaft diameter with a minimum of 2 gallons.
- Fluid level in the reservoir should be maintained at least one inch above the return line from the seal to prevent loss of flow due to head pressure.
- Avoid sharp bends or elbows in tubing to reduce frictional losses.
- Use a minimum of .500" to .625" diameter tubing for the circulation system.
- Slope horizontal runs upward (1 to 5 degrees) from the seal back to the reservoir to prevent air entrapment.
- Use free-flowing valves to isolate the reservoir from tubing lines. This aids the venting process, ensuring a fluid-packed system.
- If possible, locate the circulating ring in the gland where clearances can be more tightly controlled and tangential connections can be used.
- Low-level or low-pressure alarms may be added to detect and warn of internal leakage past the inboard seal.

Maintaining Reservoir Fluid Levels

There are several ways to maintain barrier fluid levels in the reservoir. The dual pressurized seals will "weep" some of the barrier fluid into the process. Typical leak rates of about 45 drops or 2½ cc/day will require periodic addition of fluid to the seal pot. One method is to bleed off the reservoir and add barrier fluid when the pump is not operating and there is no pressure on the system. However, if the pump is operating, you must keep pressure on the system at all times to ensure the seal does not experience a pressure reversal. One approach, although not the best, is to isolate the seal chamber by closing the valves on the tubing to and from the seal, bleed off the pressure in the reservoir, add fluid, re-pressurize the reservoir, and then re-open the valves. The problem with this method is that the seal is operating "dead-ended" with the barrier fluid not circulating. Depending upon the length of time, as well as temperature and pressure, the artificial environment could be affected.

There are systems with "make-up" pots that will enable manual pumping to the primary reservoir while it is under pressure. These systems add expense and, depending upon the operating pressures, may take time and energy to manually pump the fluid from the "make-up" pot to the primary reservoir.

A common mistake is to take the pressure off the system while the pump is operating. This then creates a pressure reversal, and depending upon the seal design, may contaminate the seal chamber with the pump product. Seal performance and life will be affected when this situation occurs.

Next Month: Sealing vertical shafts with standard mechanical seals.

The *Mechanical Seal Division* of the *Fluid Sealing Association* is one of six with a specific product technology focus. As part of its educational mission, it develops publications such as the *Mechanical Seal Handbook,* a primer intended to complement detailed manufacturer's documents produced by the member companies. A more recent contribution is the *Life Cycle Cost Estimator,* a web-based software tool for determination of pump seal total Life Cycle Costs (LCC). The following members of the *Mechanical Seal Division* sponsor this *Sealing Sense:*

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