

SEALING SENSE

When and how do I use API Flush Plan 54?

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 ISO 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 than 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.

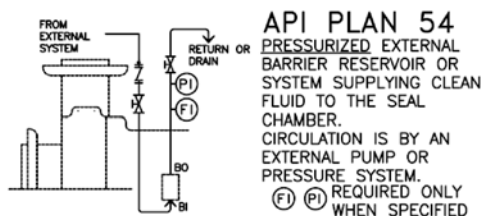


Figure 1. Diagram of the API Plan 54 Flush System.

API Plan 54 utilizes an external source to provide a clean pressurized barrier fluid to a dual pressurized seal. This system can range from a process pump in the operating unit providing this fluid, to a simple lubrication system with minimal components, to a fully instrumented system with complete redundancy designed to alarm against, and prevent, malfunctions and process upsets. Figure 2 shows a simple system with a 10-gal capacity.

The intent of this flush plan is to isolate the process fluid from the atmosphere, either for environmental considerations or the fact that it creates an unsuitable environment in the seal chamber. Since the Plan 54 is configured to operate at minimum of 25-psi above the seal chamber pressure, both the inboard and outboard seal faces are lubricated by the barrier fluid and a very favorable sealing environment is created. As with any dual pressurized seal application, a small amount of barrier fluid will migrate across the seal faces, ensuring virtually zero process leakage to the atmosphere.



Figure 2. A Simple API Plan 54 Flush System.

API Plan 54 does provide some distinct advantages over other dual pressurized flush plans, namely:

1. Selection of a barrier fluid possessing exceptional lubricating properties can result in extended MTBPM (Mean Time Between Planned Maintenance).
2. The barrier fluid is not susceptible to nitrogen entrainment, as is the case with API Plan 53A. This allows Plan 54 to operate in much higher pressure applications.
3. Flow to the seal is not dependent upon a pumping ring and/or thermo siphon, which relaxes many of the mounting considerations associated with other plans. This also means actual required flow rates can be achieved, thus maximizing seal life.
4. Heat removal can be achieved via a heat exchanger, water or air cooled, allowing for use in higher temperature applications.
5. Filters can be included with the system, ensuring clean barrier fluid is supplied to the seals.

6. Properly instrumented, the system can protect against process or pump upset conditions.
7. Multiple seals can be serviced by one system when properly sized and instrumented.

However, as with any flush plan, consideration must be given to proper system sizing and control.

Sizing

The flush flow rate must account for not only the energy from the mechanical seal, namely heat soak and face generated heat, but from the pump(s) supplying the barrier fluid as well, which can be significant in larger systems with elevated flow rates.

On stand-alone units (non process or operating unit associated) a heat exchanger is recommended to remove the energy noted above. Proper sizing of this component is critical as well.

Lastly, the barrier fluid reservoir, which is typically atmospheric, must be sized to provide sufficient retention time. This serves to not only allow for additional heat dissipation, but allows for any contaminants that may have been picked up in the seal chamber to settle out, as well as allowing for any foaming of the barrier fluid to dissipate. The minimum recommended retention time is three minutes, however, the longer the retention times the better.

Control

The system pressure is controlled downstream of the seal(s) and can be achieved via one of the following methods:

1. Constant pressure regulator

2. Pressure tracking regulator
3. Control valve

The system pressure should be set as previously noted and, in the event multiple seals are supported by a single system, must take into consideration the highest seal pressure supported by the Plan 54.

Flow to individual seals can be controlled by means as simple as an orifice to manual needle, or globe valves to self-adjusting constant flow valves.

Additional consideration should be given to the following:

1. Redundancy of critical components, i.e. pump and motor, filter, heat exchanger, instrumentation, given the criticality of the seal(s) supported by the Plan 54.
2. Instrumentation to monitor the barrier fluid level in the reservoir.
3. Precautions to prevent contamination of the system in the event of an inboard seal failure or upset.

When properly applied and operated, API Plan 54 can increase the MTBPM for many difficult sealing applications, such as high pressure and/or temperature or highly abrasive process fluids.

Next Month: *Would a rubber or metal expansion joint better suit my application?*

We invite your questions on sealing issues and will provide best efforts answers based on FSA publications. Please direct your questions to: sealingquestions@fluidsealing.com.

P&S

Fluid Sealing Association

Sealing Sense is produced by the **Fluid Sealing Association** as part of our commitment to industry consensus technical education for pump users, contractors, distributors, OEMs, and reps. As a source of technical information on sealing systems and devices, and in cooperation with the **European Sealing Association**, the FSA also supports development of harmonized standards in all areas of fluid sealing technology. The education is provided in the public interest to enable a balanced assessment of the most effective solutions to pump systems technology issues on rational Total Life Cycle Cost principles.

The **Mechanical Seal Division** of the FSA is one of five with a specific product technology focus. As part of their educational mission they develop publications such as the *Mechanical Seal Handbook*, a primer intended to complement the more detailed manufacturer's documents produced by the member companies. Joint FSA/ESA publications such as the *Seal Forum*, a series of case studies in pump performance, are another example as is the *Life Cycle Cost Estimator*, a web-based software tool for determination of pump seal total Life Cycle Costs (LCC). More recently the *Sealing Systems Matter* initiative has been launched. It is directed to support of the case for choosing mechanical seals that optimize life cycle cost,

safety, and environmental compliance.

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