

# Determine the Best Piping Plan for Supporting Mechanical Seals in Vertical Pumps

Understand how different pump types impact seal chamber pressure.

By **Garrett Marsala**  
FSA Member, Flowserve

Getting the most out of a mechanical seal is directly proportional to the quality of the environment in which it operates. In nearly every application, the key to mechanical seal longevity and extended mean time between failure (MTBF) is understanding the needs of the mechanical seal and how it should be supported. Although every application is unique in its mechanical sealing requirements, vertical pump applications present a specific set of challenges.

When determining the best piping plan(s) to support a mechanical seal, it

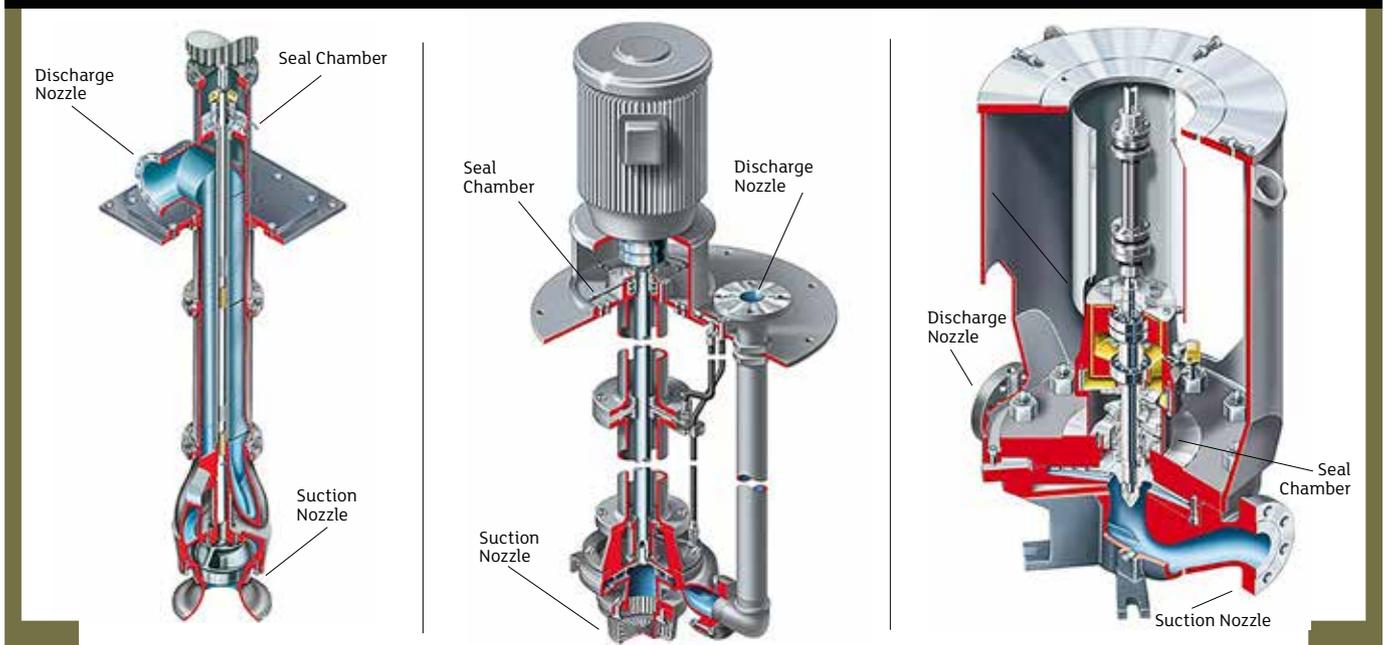
is important to first understand how different types of pumps may affect the seal chamber pressure. For example, the seal chamber pressure on a vertical overhung pump (OH3) is going to depend on specific impeller features. Whereas for a vertical sump pump (VS5), because the discharge piping is run outside of the shaft column, the seal chamber pressure will be very close to atmospheric pressure. This article focuses on three unique pump categories: vertical turbine and wet pit pumps, vertical sump and slurry pumps and vertical overhung pumps.

## Vertical Turbine & Wet Pit Pumps (VS1, VS2, VS3, VS6 & VS7)

The mechanical seal in a vertical turbine or wet pit pump is located in the shaft column above the mounting plate of the pump. Process fluid is brought up through the shaft column and exits the pump from the discharge nozzle.

Because of this, the seal chamber pressure will be equivalent to the discharge pressure of the pump. The mechanical seal will need to be properly vented to prevent vapor lock, so the flush port should be as high as possible axially (above the seal faces).

Figure 1 (left). Wet pit pump cross section; Figure 2 (middle). Vertical sump pump cross section; Figure 3 (right). Vertical overhung pump cross section (Images courtesy of Flowserve)



The most common piping plan selected for these kinds of pumps is an American Petroleum Institute (API) Plan 13, which needs to be sized to provide adequate flush flow over the seal faces to keep them cool and lubricated. The primary advantage of API Plan 13 in this arrangement is that it allows for continuous venting of the process fluid to avoid accumulating vapor in the seal chamber and vapor-locking the seal.

The axial positions of the flush ports become important when operating a vertical mechanical seal. To promote the best possible venting scenario, the flush-out (FO) ports should be located as far outboard as possible, above the seal faces. In contrast, for any vertically oriented seal, the flush-in (FI) ports should be below the FO ports. If possible, flush porting in the mechanical seal should be tangential to promote ease of flow throughout the seal.

API Plan 13 can be used to remove solids from the seal chamber as well. If there are solids in the process fluid, it is advised to use API Plan 13 in conjunction with a bleed bushing (usually supplied by the pump manufacturer) and include API Plan 32 for proper seal chamber flushing.

**Vertical Sump & Slurry Pumps (VS4 & VS5)**

Vertical sump and slurry pumps differ from vertical turbine pumps in that the process fluid is not discharged through the shaft column. A separate run of piping is connected to the discharge nozzle so that the process fluid is discharged outside the shaft column to a separate location.

This leaves the majority of the shaft column empty (filled with air or vapor) and at atmospheric pressure. Since this is the case, the mechanical seal is only required to keep unwanted vapors from leaking into the atmosphere. Depending on the piping plan selected, a gas or liquid barrier fluid system can be used to accomplish this.

API Plans 53, 54 and 74 provide a pressurized barrier fluid (liquid barrier for Plan 53 and 54, gas barrier fluid for Plan 74) into the seal in order to contain the process fluid from leaking into the atmosphere. This can be most critical when sealing a vertical sump or slurry pump where vapor can accumulate in the shaft column. If a pressurized barrier system is selected for a vertical sump or slurry pump, it is crucial to ensure that a drain port is available in the shaft column. If the drain port is not present, the shaft column could fill with fluid and overpressurize the seal.

**Vertical Overhung Pumps (OH3, OH4 & OH5)**

In a vertical overhung pump, the mechanical seal is right above the back of the impeller, much like in a horizontal overhung pump. Since this is the case, the features in the impeller will have a significant impact on the pressure acting in the seal chamber. Wear rings facilitate close-clearance interaction between the impeller and the pump casing in order to keep fluid at discharge from recirculating back to suction. They also reduce the axial loading on the impeller by decreasing the differential pressure between the front of the impeller and the seal chamber. Depending on the features of the impeller, the seal chamber pressure would be between suction and discharge pressure for vertical overhung pumps.

Balance holes are holes in the impeller that allow for high pressure behind the impeller (and in the seal chamber) to pass through the impeller into suction. This also reduces the axial loading on the impeller and brings the seal chamber pressure close to suction pressure.

Throat bushings are between the back of the impeller and the throat of the seal chamber and are used to build pressure in the seal chamber, isolate process fluid from flush fluid in the seal chamber or to act as a journal bearing to help center the shaft before entering into the seal

**SUMMIT™**

Your *Best Value* in Progressive Cavity Pumps

**SPPC**



**Gear Joint**



**Pin Joint**



**Wobble**

*Celebrating over 33 years*

Call or Email:  
920-869-4800

[sales@summitpump.com](mailto:sales@summitpump.com)



**SUMMIT™ PUMP, Inc**

[www.SUMMITPUMP.com](http://www.SUMMITPUMP.com)

**BASED IN GREEN BAY, WI**

Circle 131 on card or visit [psfreeinfo.com](http://psfreeinfo.com).

## Predictive Maintenance with the AT5™ Motor Tester



- ✓ Immediate electric motor health analysis within instrument
- ✓ Cost-effective maintenance of Water Utility assets over long life cycles
- ✓ Detect early faults in AC & DC motors, transformers & generators
- ✓ Route-based testing and trending - ideal for predictive maintenance
- ✓ Tests can be performed from distances of more than 1,000 feet away
- ✓ Report shows bad connections, winding & turn faults, air gap, broken bar, contamination and ground faults

# AT PRO

The ideal instruments for troubleshooting, quality control and predictive maintenance of electric motors, transformers and generators.

[www.alltestpro.com](http://www.alltestpro.com)

Circle 127 on card or visit [psfreeinfo.com](http://psfreeinfo.com).

**Consider how pump equipment can affect seal chamber pressure so the proper piping plan can be selected. If properly supported, a mechanical seal will have its best chance at operating in a reliable and effective manner.**

chamber. Depending on its length and clearance over the shaft, throat bushings will have an effect on the pressure acting on the mechanical seal and will need to be considered when selecting a piping plan.

The most common piping plans for vertical overhung pumps are API Plan 13, 14 and 32. Each of these piping plans provide a flush flow over the mechanical seal faces to keep them cool and lubricated.

API Plan 13 brings the flush fluid from the seal chamber back into suction. This can be used to help lower the seal chamber pressure, assuming the seal chamber pressure is greater than suction pressure.

API Plan 14 uses the differential pressure between suction and discharge to produce continuous venting and a constant flow through the seal chamber. Vertical overhung pumps use an API Plan 14 to increase the pressure in the seal chamber if vapor pressure margin is an issue, while simultaneously achieving continuous venting and flush flow. This can prevent long dry running at start-up in some cases.

API Plan 32 brings cool, clean flush fluid into the seal chamber from an external pressure source. At a minimum, API Plan 32 should be used to fill the seal chamber before starting up the pump when needed. An additional vent port would also be added to the mechanical seal to vent the seal chamber. If used to remove solids from the

seal chamber, it is recommended that a bleed bushing be used in conjunction with the API Plan 32.

In order to best support a mechanical seal in a vertical pump, it is important to consider how the pump equipment can affect the seal chamber pressure so that the proper piping plan can be selected.

And if properly supported, a mechanical seal will have its best chance at operating in a reliable and effective manner. ■

### Next Month: Testing standard for quarter turn valves

FLUID SEALING ASSOCIATION **FSA**

We invite your suggestions for article topics as well as questions on sealing

issues so we can better respond to the needs of the industry. Please direct your suggestions and questions to [sealingsensequestions@fluidsealing.com](mailto:sealingsensequestions@fluidsealing.com).

**Garrett Marsala** is an applied technical solutions engineer for Flowserve and has been working with customers within the flow industry since 2012. He holds a bachelor's degree in mechanical engineering from the University of California, Riverside.

