WHITE PAPER
SEAL-FREE PUMP DESIGNS MINIMIZE LEAKS AND PUMP FAILURE

RUTHMAN
Engineering Pump Solutions™

Gusher Enclosed Column Vertical Pumps & Deming Vertical Turbine Pumps eliminate mechanical seal failure headaches, downtime, and cost

One of the most common pump problems encountered by plant maintenance engineers is leaking pumps. Depending on the severity of the leak, this can cause problems for your system, increase chemical costs, create hazardous conditions for your workforce, and expose you to potential EPA fines. Downtime and cost to repair these leaks can add up to significant expense over the life of a pump, often exceeding the initial cost of the pump itself.

The cause of these failures is often a faulty sealing method–either compression packing, or more commonly, a mechanical seal. In fact, we estimate that up to 85% of all pump repair calls are due to seal failure. By implementing a seal-free design, this point of failure is eliminated.

Ruthman Companies offers this beneficial design in its Gusher Enclosed Column Vertical Pump and its Deming Vertical Self-Seal Turbine Pump (manufactured exclusively by our Process Systems, Inc division). In the design of these pumps, careful engineering and manufacture remove the need for active packing or mechanical seals. Any incidental leakage (which is typically minimal) is collected either in the column enclosure or self-seal case and returned to the process supply tank or suction side of the pump.

Packing Presents Problems

In the early days of pumps, packing was the typical sealing method to keep process liquid from leaking around the shaft opening. While this approach works at slowing the leaks down, it is an imperfect solution. It must always have a small amount of leakage to assure there is fluid throughout the packed area to lubricate the shaft. As the packing and shaft wear, the packing requires frequent adjustment of the amount of compression to control the leakage rate. Too much compression of the packing causes serious wear on the shaft and results in increasingly more significant leaks. This wear eventually leads to requiring shaft replacement, at significant cost.

Even the highest-performing packing materials don't function properly on pumps with any significant shaft wear, misalignment, or other damage. Additionally, the packing material degrades over time, compromising its integrity. Replacing the packing is no guarantee of reliable sealing. If the inside of the stuffing box becomes corroded, it will prevent the new packing from sealing. Likewise, any leftover packing or debris can create uneven seating, which can cause leakage. Wear on the shaft and packing box can alter its dimensions, compromising the fit of new packing rings, dramatically increasing leakage.

Given the finicky nature and significant maintenance requirements of packing, it's no wonder that pump users searched for a better sealing method. The most common upgrade from packing is a mechanical seal.

The Failed Promise of Seals

To overcome the shortcomings of packing, mechanical seals were introduced, with the promise that they would minimize maintenance and eliminate leaks. They do not live up to that promise; at least not for long. Instead, mechanical seals have become the pump industry's biggest nemesis.

Mechanical seals are known to fail. Anyone that operates sealed pumps can tell you that they deal with continual leakage and repeated downtime for repair.

A mechanical seal consists of two primary faces of extremely smooth material. One of the faces rotates with the shaft. The second face remains stationary with the pump. These two very smooth faces spin on the face of the other. To lubricate these faces, there must be a film of fluid between them. This film of fluid is engineered to leak to the atmosphere. Ideally, this leakage is so slow that it evaporates rather than collects. Some fluids, such as oil, have a low evaporation rate and the leakage can accumulate into a sticky mess.

When these two smooth faces become misaligned, the seal fails, causing process fluid to leak from the shaft opening and collect. Even a momentary misalignment and leakage can cause lasting problems. If the fluid contains solids, the solids can work their way between the seal faces and cause ongoing misalignment. Once a seal has failed, it can cause other issues, both environmentally and financially with the loss of hazardous and/or expensive fluids. This leakage could also contaminate and damage the pump's bearing housing. This simple failure can cost thousands of dollars to repair and costly machine downtime and labor.

To be fair, most commonly the cause of the failure is not the fault of the seal itself. Vibration from shaft movement, air entrainment, cavitation, solids, or improper operation (such as running a seal dry) can all cause the seal to fail. If the failure can be shown to be a result of any of these conditions, seal and pump manufacturers generally deny warranty claims, adding to the cost of repairs. Regardless of cause, the end result is the same–downtime and expense.

To combat these failures, seal manufacturers offer expensive premium seals with new technology–wavy face seals, narrow contact seals, diamond face seals, and other approaches, all at very high price points. The premium seals can cost as much as or more than an entire pump and motor. However, given that most seal failures are not the fault of the seal itself, but rather how they are applied or operated, a premium price point doesn't guarantee problem-free operation.

For difficult fluids, especially abrasive or sticky fluids, double mechanical seals are also offered as an option. The design of a double mechanical seal has two sets of mechanical seals, each with a rotating and stationary face. In between these sets of mechanical seals is an area that must be pressurized with clean fluid at a pressure higher than the fluid on the inboard side of the primary faces.

This requires the addition of an entire seal flush support system. This added seal support system adds significant cost. Further, it typically requires yet another pump to pressurize the seal flush system, actually increasing the potential for more pump seal failure. Often, these systems yield even more operator frustration and expensive seal replacements.

Dynamic seals are another advancement that sound good in theory (eliminating the contacting parts to eliminate motion-related failure), but often fail to deliver in practice. In reality, dynamic seals can fail as much as or more often than standard mechanical seals. Their success depends largely on the application.

Mag Drive Sealless at Max Cost

An expensive alternative to seal options is a magnetic drive sealless pump. Since all seals leak, this may be the only option for some dangerous toxic fluids that simply cannot have vapor leaks to atmosphere. These pumps also work well for clean fluids that have good lubricity–all of the load bearing points are lubricated by the fluid itself.

But they are not good for fluids that contain abrasive particles or solids. They are also extremely vulnerable to air entrainment since centrifugal forces on these designs cause air to collect near the shaft and bearings. Due to the nature of the magnet design, these pumps are difficult to work on, are limited in size and horsepower. and can be dangerous to any personnel with heart pacemakers.

With their limitations, mag drive sealless pumps are a great option for the "right" application, but costly overkill in most pump applications– like using a sledgehammer to crack a nut.

The Real Deal, Seal-Free Solution

A great, but little-known solution to these imperfect sealing methods for many applications? Eliminate the need for a sealing method altogether. A well-constructed seal-free pump first reduces any leakage to a minimal amount. Secondly, it collects and contains this leakage within the system and returns it to the suction side supply tank or suction pipe. By design, there is no leakage allowed externally. We offer this technology on our Gusher Enclosed Column 7550, 7550 Vortex or 7800 Series pumps and on our Deming and Process Systems Vertical Turbine Pumps.

How it works

The concept is simple: we significantly reduce the amount of leakage, then contain it and return it to its low-pressure source. The cost for this option is relatively insignificant compared to traditional seal options.

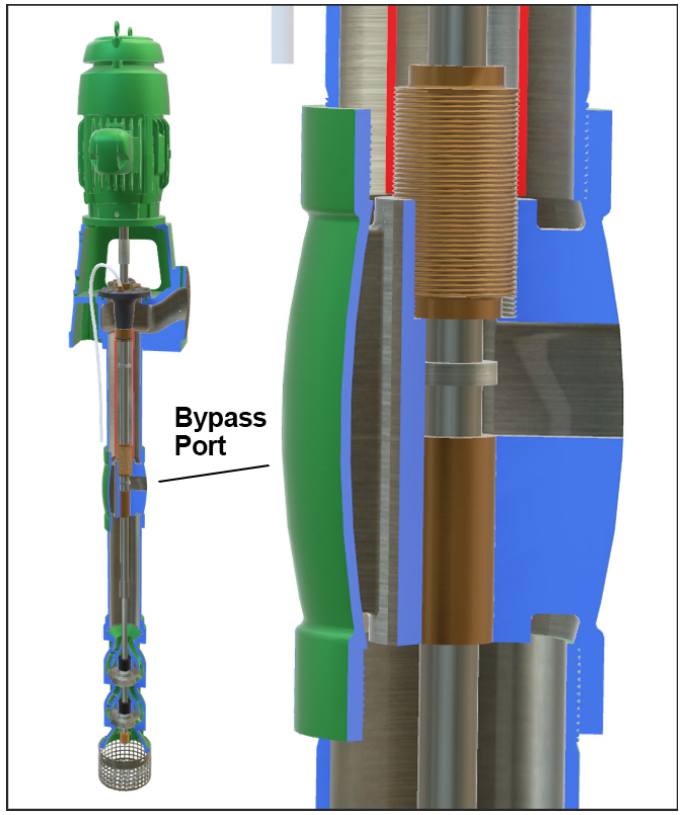
In the Gusher pump designs, we use standard pump wet end components, such as ANSI wet ends, Vortex wet ends, or our 7800 Series pump components. On these standard pump wet ends, we use a semi-open impeller with back pump-out vanes to help reduce the pressure within what would otherwise be called the seal chamber. In this 'seal chamber' (which does not contain a seal), is a throttle bushing which further reduces pressure and flow around the shaft opening in the top of the pump casing.

Finally, a column enclosure collects whatever fluid makes it past the throttle bushing during normal operation. At times there may be zero flow, and depending on operating conditions, the flow out of this throttle bushing may be a few gallons per minute. Whatever the flow is, it is collected within the enclosed column. If and when enough fluid collects within the enclosed column, it is returned either to the supply tank or to the suction pipe in front of the pump via an overflow port.

A Gusher 7550 Enclosed Column Pump

These ports are situated just below the highest liquid level allowable within the enclosed column. This highest allowable liquid level is 1 to 2 inches below the mounting plate. This must be no lower than the highest liquid level in the supply tank, to prevent any leakage out of the top of the column. With a vertical design, gravity is our friend in creating a simple, reliable and inexpensive solution.

The Process Systems and Deming Vertical Turbine pump designs are quite similar to the Gusher design. The standard vertical turbine wet end is constructed with a lower throttle bushing that limits pressure and flow above the impeller casing. The shaft is enclosed in a tube and sealed with a non-rotating O-ring. The shaft above the column case does not come in contact with the pumped liquid.



A Deming Self-Seal Vertical Turbine Pump

As the process fluid passes up through the lower column assembly, it enters the Self-Seal column case, located below the discharge head. Bypass ports allow a small amount of liquid to pass around the shaft as it moves through the lower column case bearing.

Any fluid that flows past the lower bushing in the Self-Seal case is vented back to the tank or well via a set of bypass ports. From the Self-Seal case upward, the shaft is enclosed in a dry tube away from the fluid, making it impossible for leaks to occur at the point the shaft passes out of the discharge head.

This design is suitable for even high-pressure vertical turbine applications. We have designed self-seal vertical turbine pumps producing as much as 600 PSI.

Proven Performance

The seal-free design is so simple yet proven with decades of leak- and maintenance-free operation in industrial installations. These pumps are suited to a wide variety of challenging applications–even those with high solids or with high temperature fluids. The only installation where they are not an option is on a pressurized inlet. This is not an experimental product. We have been manufacturing them for over 30 years with excellent reliability.

Typically, the only preventive maintenance required is normal greasing. As an added benefit, not only are leakage and pump repairs due to seal failure completely eliminated, this design also saves floor space and minimizes regular maintenance compared to a horizontal pump in the same application.

Easy to Retrofit

Often facilities are forced to live with frequently failing mechanically-sealed pumps because of the cost and time involved in changing piping and support structures to accommodate a new pump style. Ruthman Companies' divisions have built their reputations on custom engineering. Our design flexibility eliminates the trade-off between ongoing maintenance headaches and potential construction headaches with a pump configuration tailored to fit the existing footprint and applications needs.

Given our in-house engineering expertise, even challenging installations can be accommodated with a seal-free design. Within this offering, we have many options.

Some of our capabilities:

- To handle large solids, a recessed impeller or vortex pump with hardened materials can be utilized.
- For corrosive applications, we can offer 316 Stainless Steel or other more exotic materials of construction.
- Pump applications that handle large amounts of air are frequently hardest on mechanical seals. An enclosed column seal-free design coupled with a recessed impeller vortex wet end can handle up to 30% air.
- For applications that experience frequent loss of prime, we can design a full cantilever pump with no contacting parts below the bearing housing. This design can run dry without damage.
- In applications that currently utilize an ANSI pump, we can typically replace it with the same size and similar performance sealless vertical pump, utilizing our ANSI wet end components of the same size, such as a 4x6-10.
- For applications with higher pressures or flows where a single stage pump in not feasible, the sealless Vertical Turbine Pump is an option, delivering leak-free performance with high efficiency.

Let Us Solve Your Pump Problems

By eliminating the need for mechanical seals, Gusher's Enclosed Column and Process Systems and Deming Vertical Turbine pumps provide long, reliable service life. Bring us your serious pump problems and we'll help you solve them with simple, proven pump engineering.

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GUSHER® PUMPS

DEMING VERTICAL TURBINE PUMPS

Manufactured by:
Process Systems®, inc.