Preventing Pump Failure in Oil and Gas Service

AODD PUMPS PROVIDE THE INTRINSIC SAFETY, APPLICATION FLEXIBILITY AND RELIABLE PERFORMANCE NEEDED ACROSS UPSTREAM, MIDSTREAM AND DOWNSTREAM OPERATIONS

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Introduction

Imagine morning rounds at a remote tank battery turning up one thing no operator wants to find: a sheen of produced water spreading beneath the transfer pump, where a worn mechanical seal finally let go overnight. The rest of the day belongs to containment, cleanup and a reportable-spill call.

In truth, the pump had been announcing its unsuitability for months. It lost prime whenever the produced water came in gas-cut. It wore out its seal by running dry during tank changeovers. Entrained sand chewed through its internals. And all of it happened with an electric motor sitting just feet from flammable vapors. The leak was not an isolated failure. It was the predictable result of asking the wrong technology to do oilfield work.

Scenarios like this play out every day, because behind the industry's constant motion is an enormous amount of fluid transfer. From wellhead to refinery gate, crude oil, drilling mud, produced water, fuels, glycol and aggressive chemical additives must move reliably between wells, separators, tanks, trucks and treatment systems. Often conducted in remote locations and extreme temperatures, these transfers take place in hazardous environments where a single spark could be catastrophic, all under the pressure of increasingly stringent environmental regulations.

In these operations, pumps determine whether the product keeps moving or the process stalls, and whether crews and the environment stay protected while it does. This white paper examines the fluid transfer challenges found across upstream, midstream and downstream operations, and how air-operated double-diaphragm (AODD) pumps deliver the intrinsic safety, application flexibility and reliable performance these environments demand.



Industry Overview and Market Trends

Despite the ongoing global energy transition, oil and gas remain foundational to the world economy, powering transportation, electricity generation, heavy industry and petrochemical production. Industry analysts estimated the global oil and gas market at more than $6 trillion in 2025, with projections of continued growth at a compound annual rate of roughly 4% over the next decade. Asia-Pacific remains the largest regional market, driven by industrialization and rising energy demand in China and India. At the same time, North America continues to expand production through unconventional resources such as the Permian Basin and a rapidly growing liquefied natural gas (LNG) export infrastructure.

Natural gas, in particular, is playing an increasingly central role as a transition fuel, and global LNG export capacity is expected to grow substantially through 2030. That growth is expanding investment in gas processing, dehydration and pipeline infrastructure, all of which depend heavily on fluid transfer equipment.

At the same time, the industry faces mounting pressure to operate more cleanly and efficiently. Operators are investing in methane emissions monitoring, spill prevention and produced water management to satisfy regulators and stakeholders. Capital discipline remains a priority, which places a premium on equipment uptime, maintenance simplicity and total cost of ownership. Together, these trends mean that process equipment must do more than simply move fluid. It must do so safely, cleanly and reliably in some of the harshest working environments in industry.

Operational Challenges Affecting Pump Selection

While market conditions remain favorable, oil and gas operators must manage a distinct set of operational challenges that directly affect the selection and deployment of fluid transfer equipment.



Hazardous Areas

Oil and gas facilities routinely handle fluids that are not only corrosive and abrasive but also highly flammable, including crude oil, condensates, fuels and solvent-based chemical additives. Many work areas are classified as hazardous locations, such as Class I, Division 1 areas in North America or ATEX zones internationally, where volatile hydrocarbons or flammable gases may be present in the atmosphere. In these environments, any equipment that can generate a spark or excessive heat represents an unacceptable ignition risk. When handling flammable fluids or operating in areas prone to static

hazards, proper grounding of all pumps, valves, and containers is essential. Furthermore, any equipment used in these classified environments must be specifically rated for safe operation.

Constantly Changing Tasks

Oilfields are rarely controlled environments. Temperatures fluctuate widely, equipment is frequently relocated and operational demands shift rapidly. A pump may be needed for mud mixing at a drilling operation one week and for produced water transfer at a nearby separation unit the next. Fixed, hard-piped equipment that requires electrical infrastructure, skilled trades or specialized tools to redeploy cannot keep up with this pace. Operators need fluid-handling equipment that is portable, tolerant of interrupted or fluctuating flow, and simple enough for field personnel to move and restart.

Environmental Regulations

Environmental oversight of oil and gas operations continues to tighten. Agencies such as the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) impose requirements covering spill prevention, leak containment, emissions and the handling and disposal of produced water and other waste fluids. A leaking pump is no longer just a maintenance nuisance. It can trigger environmental contamination, regulatory violations and significant legal and financial exposure. Equipment that minimizes leak paths and contains product reliably helps operators reduce that risk while supporting a safer work environment.

Entrained Gases in Process Fluids

In many oil and gas operations, process fluids contain entrained gases, or small gas bubbles mixed within the liquid. This condition is problematic for many pump technologies. Centrifugal and other rotary pumps can lose prime, cavitate or stall when gas is present, disrupting flow and risking equipment damage. Gas-laden fluids are common in separators, knockout drums and flare knockout systems, where separating gas from liquid is essential before safe flaring. AODD pumps, by contrast, are inherently tolerant of entrained gas and can continue pumping without losing prime or pressure, making them dependable in exactly the situations where other technologies might fail. This distinction is one of the clearest examples of why pump selection matters in oil and gas service.

Four Major Oil and Gas Pump Applications

Fluid transfer needs span the entire oil and gas value chain, from drilling pads to processing facilities. The following applications represent some of the most common and most demanding pumping duties in the industry.

Dewatering



Dewatering is the removal of water from fluids, solids or systems during drilling, production or treatment operations. It is a critical step in maintaining efficiency, safety and environmental compliance, and it takes several forms across the oilfield.

In drilling operations, water must be separated from drilling mud and cuttings to reduce waste volume and improve mud reuse. In produced water treatment, water produced with oil and gas must be managed carefully. Produced water is naturally present in the reservoir and often contains salts, hydrocarbons, heavy metals and chemical additives used in drilling or stimulation. Because of environmental regulations, it must be separated, filtered and either reinjected into the reservoir or sent to disposal wells.

Condensate water presents a related but distinct challenge. It forms when natural gas cools in pipelines, separators or processing equipment. While it is typically cleaner than produced water, it may still contain hydrocarbons or other contaminants and is often collected and treated within gas processing and dehydration systems. Pipeline and tank dewatering clears water from pipelines and storage tanks before hydrocarbons are introduced, preventing contamination and corrosion. Finally, frac flowback operations separate water from flowback fluids after hydraulic fracturing, enabling water recycling and reducing environmental impact.

Slurry Transfer



Slurry transfer involves moving mixtures of solids suspended in liquid, typically water or drilling fluid, from one location to another. Oilfield slurries commonly contain drilling cuttings,

drilling mud, sand, silt and chemical additives. These abrasive, high-solids mixtures appear throughout the oilfield. In drilling operations, cuttings-laden mud is moved from the well to separation equipment. In waste management, slurries are transferred to holding tanks or disposal sites. And in hydraulic fracturing, flowback fluids carry suspended solids from the well. Slurries punish pump technologies that rely on tight tolerances or high-speed rotating components, making solids-handling capability a key selection criterion.

Drilling Mud



Drilling mud, also known as drilling fluid, is a specially formulated mixture used during drilling operations to support and stabilize the wellbore. It cools and lubricates the drill bit, carries rock cuttings to the surface, controls downhole pressure to prevent blowouts, stabilizes borehole walls and seals porous formations. Muds are blended from a base fluid, whether water-based, oil-based or synthetic-based, along with additives such as bentonite clay for viscosity, barite for weight, and polymers and corrosion inhibitors for fluid control and equipment protection. The result is a dense, abrasive fluid that must be continuously mixed, transferred and recirculated, placing heavy demands on the pumps that handle it.

Chemical Injection



Chemical injection is the controlled delivery of specific chemicals into a well, pipeline or processing system to improve performance, protect equipment and ensure safety and compliance. Common programs address a range of threats. Corrosion inhibitors protect pipelines and well tubing from attack by water, carbon dioxide and hydrogen sulfide. Scale inhibitors prevent mineral buildup, while hydrate inhibitors such as methanol and glycols keep pipelines from blocking in cold or high-pressure conditions. Demulsifiers improve oil-water separation, and biocides control microbial growth and souring. Glycol also circulates continuously through dehydration systems that remove water vapor from natural gas. Injection rates must be carefully controlled based on flow conditions and fluid composition, which requires pumps that offer precise, adjustable delivery and broad chemical compatibility.

Why AODD Pumps Are Suitable for Oil and Gas

AODD pumps use compressed air to shift two diaphragms that alternately draw fluid into and discharge it from opposing liquid chambers. This simple operating principle produces a combination of characteristics that has made AODD pumps a reliable technology across upstream, midstream and downstream applications in oil and gas.



The most fundamental of those characteristics is safety. Because AODD pumps are powered by compressed air rather than electricity, they contain no electrical components that could generate a spark, a critical attribute in explosive atmospheres and classified hazardous locations. Since AODD pumps are powered by compressed air, they are compliant with ATEX grounded and each pump will have a specific ATEX categorization denoting what explosive environment they are safe to use in. The diaphragm design also eliminates dynamic seals, which are prone to wear and leakage in other pump technologies. That dramatically reduces the risk of hazardous spills, environmental contamination and costly downtime, especially when handling aggressive or toxic fluids.

The same architecture makes AODD pumps unusually tolerant of real-world field conditions. They are self-priming and can start without fluid in the lines, even when suction lift is required, eliminating the need for manual priming and simplifying setup. They can also run dry without damage, which is crucial when flow is interrupted by tank changes, valve closures or unexpected downtime, making them highly adaptable to fluctuating flow conditions and intermittent transfer needs.

Operators gain a similar degree of flexibility in how the pumps perform and where they work. By simply adjusting the air

supply, personnel can fine-tune flow and pressure without complex electronic controls, providing precise handling of viscous, abrasive or shear-sensitive materials. And because the pumps are compact and lightweight, they can be quickly relocated and integrated onto skids or mobile units, supporting field operations and temporary setups without specialized tools or electrical infrastructure.

Together, these characteristics make AODD pumps remarkably versatile across the value chain, supporting upstream duties such as drilling support and chemical injection, midstream duties such as tank transfer and pipeline support, and downstream duties such as waste fluid handling and spill response.

They also translate directly into risk reduction. AODD pumps contribute to a safer work environment, help operators maintain compliance with OSHA, EPA and other regulatory requirements, and reduce exposure to the legal and financial consequences of equipment failure or safety violations. For operators and facility managers, that means greater peace of mind and a more compliant worksite.

The All-Flo™ Advantage

Not all AODD pumps are built to the same standard. Construction materials, air valve design and solids-handling capability all vary from one manufacturer to the next, and those differences matter in demanding service. All-Flo™, a brand of PSG, a Dover company, has engineered its AODD pumps with several design advantages that address the specific requirements of oil and gas operations.

Simplified Air Valve Design

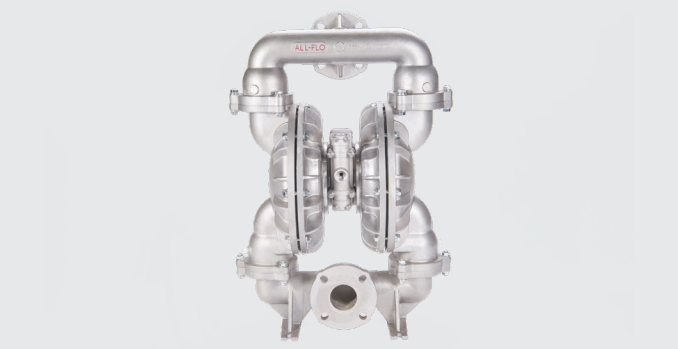
At the core of every All-Flo pump is a simplified air valve system with the fewest moving components in its class. Only three parts of the air valve move during operation. This simplicity delivers benefits on several fronts. Fewer components mean fewer potential failure points and a lower chance of unexpected breakdown, which matters greatly in remote locations where access to skilled technicians may be limited. Because All-Flo uses the same air valve design across its product line, operators can also stock fewer spare parts while supporting pumps of multiple sizes across a site. Finally, the high-efficiency valve design reduces compressed air consumption, lowering the energy cost of operation over the life of the pump.

Lightweight Construction

All-Flo pumps are engineered to be lighter than comparable units, making them easier for field personnel to carry, reposition and redeploy between tasks. In an industry where a single pump may handle mud mixing at a drilling operation one day and produced water transfer at a separation unit the next, that portability translates directly into operational flexibility and less reliance on lifting equipment or additional labor.

Standard Pump Models and Configurations

All-Flo AODD pumps are available in a range of sizes, from 1/4-inch to 3-inch connections, with flow rates up to 235 gpm (890 lpm), and in material combinations selected to match the demands of oil and gas service. Four standard configurations cover the majority of oil and gas applications.



A Series, aluminum with Buna-N or PTFE. Aluminum-bodied A Series Pumps are the workhorses of general oil and gas transfer, handling crude oil, fuel, lube oil and waste fluids. The bolted metal construction of the A Series Pumps allows for the highest level of product containment and the simplest maintenance. Buna-N diaphragms are a standard option for petroleum and oil-based fluids, providing excellent flex life, durability and moderate abrasion resistance in a cost-effective package. For fluids requiring greater chemical resistance, PTFE diaphragms are chemically inert and well suited to aggressive media such as aromatic or chlorinated hydrocarbons, acids and caustics.

A Series, stainless steel with PTFE. For chemical injection duties and other applications involving aggressive chemistries, stainless steel liquid ends paired with PTFE diaphragms provide the corrosion resistance needed to handle inhibitors, biocides, methanol and glycols safely and reliably.

A Series, aluminum with Santoprene®. For certain dewatering applications, aluminum pumps equipped with Santoprene diaphragms offer a durable, economical configuration for moving water-heavy fluids to treatment or disposal.

S Series Max-Pass®, aluminum with Buna-N or PTFE. For high-solid-content applications such as drilling muds, slurries and waste fluid transfer, the Max-Pass solids-handling pump is engineered to pass solids up to 3/4 inch (19 mm) without clogging or compromising flow, with flow rates up to 46 gpm (174 lpm). Its design ensures consistent throughput in the abrasive, solids-laden services that wear out conventional pumps.

Where non-metallic construction is preferred, All-Flo also offers conductive polypropylene and conductive PVDF liquid ends with PTFE elastomers, providing the grounding path required

for safe service in hazardous locations. Across the line, All-Flo pumps operate at air pressures up to 120 psi (8.2 bar. They are available with FNPT or ANSI/DIN flange connections to simplify integration into existing piping and skid systems.

Conclusion

Oil and gas operators work in an environment defined by hazardous locations, constantly changing tasks, tightening environmental regulations and process fluids that challenge conventional equipment. Meeting those demands requires fluid-handling technology that is intrinsically safe, tolerant of harsh and unpredictable conditions, and simple enough to maintain anywhere.



AODD pumps deliver on each of those requirements through non-sparking operation, self-priming and dry-run capability, seal-less containment and easily adjustable performance. All-Flo builds on those inherent advantages with a simplified air valve design that reduces parts inventories, improves air efficiency and lowers the chance of failure, along with lightweight construction that moves easily between tasks.

By selecting pump technology designed for the specific demands of oil and gas service, operators can protect personnel and the environment, reduce downtime and maintenance costs, and keep product flowing. The result is morning rounds that turn up nothing more than pumps doing their job.

About the Author

Sam Gilbert is a Product Manager for All-Flo. He can be reached at samuel.gilbert@psgdover.com. All-Flo is a product brand of PSG, a Dover company, Downers Grove, IL, USA. PSG is comprised of several leading brands, including Abaque, All-Flo, Almatec, Blackmer, Ebsray, em-tec, Griswold, Hydro, ipp, Malema, Mouvex, Neptune, CPC Biotech, Quantex, Quattroflow and Wilden. PSG products are manufactured on three continents – North America, Europe and Asia – in state-of-the-art facilities that practice lean manufacturing and are ISO-certified. PSG is part of the Pumps & Process Solutions segment of Dover Corporation. For additional information on PSG, please visit psgdover.com. PSG: Where Innovation Flows.

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