

A Better Choice for Food-Processing Applications

WILDEN® SANIFLO™ HYGIENIC™ AODD PUMPS EXCEL IN DIAPHRAGM
DESIGN AND OPERATION, AIR CONSUMPTION AND CLEANABILITY

By Robert Jack



Wilden® Saniflo™ Hygienic™ Series (HS) Air-Operated Double-Diaphragm (AODD) Pumps are designed to meet high-cleanliness requirements, especially those found in food-processing applications that require the safe, efficient, and hygienic transfer of low-acid, pasteurized and protein-based products.

Introduction

Air-operated double-diaphragm (AODD) pumps are commonly used in food-processing plants worldwide. AODD pumps perform many tasks well and protect the product from damage while doing them. Tyson Foods employs many AODD pumps in their poultry plants around the country. For the most part, they choose to utilize the Murzan® brand of AODD pump. This paper will compare the performance of Wilden® Saniflo™ Hygienic™ Series (HS) AODD pumps with Murzan's product and demonstrate the benefits of switching to Wilden based on the pump's diaphragms, air motor, cleanability and utility capabilities.

Wilden Benefits

1. DIAPHRAGMS: WILDEN DIAPHRAGMS OUTLAST MURZAN DIAPHRAGMS

Diaphragms are selected based on their chemical compatibility with the pumped fluid, the range of temperatures they can withstand and their adherence to sanitary standards, where applicable. Once they've been selected, their flex life is dictated by the conditions of service and their resistance to mechanical wear.

Murzan diaphragms are limited to models built with fabric-reinforced rubber materials. These are food-grade Buna, EPDM and FKM. There is a two-piece PTFE overlay available, but it is not commonly used in many operational settings.

Rubber diaphragms are compression molded of synthetic thermosetting rubber with a nylon fabric mesh positioned within the rubber to improve the diaphragm's resistance to stretching. These are labor intensive to create – an operator is required to lay in elements of rubber, fabric and more rubber into a mold, then close the press. The rubber will soften to a viscous fluid state, striking through the open mesh of the fabric-reinforcing element, while vulcanizing and completing the manufacturing process. Cycle times of 20 minutes are common.

In operation, rubber and fabric flex together while working against one another with the fabric working to cut its way out of the rubber. The result is that rubber elements crossing the fabric mesh will separate, a term called "delamination." Delamination from the fabric layer is a major contributor to diaphragm failures. Another cause of diaphragm failure is abrasion created from contact with other pump components, such as outer pistons, for example. Taken together, these two conditions cause the majority of mechanical wear and are arguably the foremost cause of diaphragm failure.



Traditional rubber AODD-pump diaphragms are compression molded and feature a nylon mesh that helps improve the diaphragm's resistance to stretching.

Wilden offers thermoplastic elastomer (TPE) materials, such as Santoprene®, branded as Wil-Flex™, and Hytrel® (branded as Saniflex™) for its food-handling products. Food-grade EPDM is available for those processors who prefer it, but Wilden recommends TPE diaphragms for this application. TPE diaphragms are manufactured using the injection-molding process. This reduces the part-to-part variability resulting from hand-lay-up manufacturing processes. Due to their dimensional stability and tensile strength, TPE diaphragms do not need fabric reinforcement. This allows for quicker cycle times, two minutes per diaphragm on average, and eliminates the delamination-failure mode. TPE diaphragms, in addition to having lower costs, also outlast fabric-reinforced diaphragm by significant margins.

Wil-Flex provides a low-cost alternative to EPDM. Made of



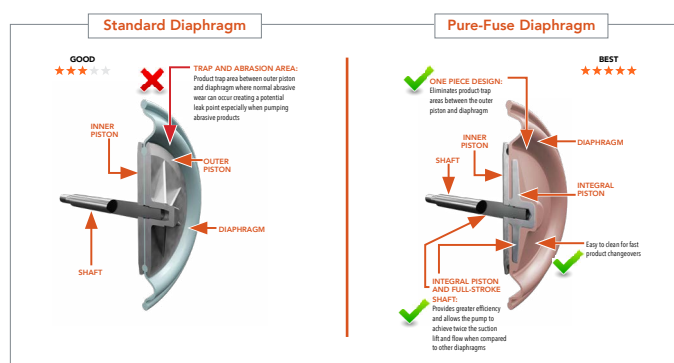
The latest diaphragm advancement from Wilden is its Santoprene® (Wil-Flex™) and Hytrel® (Saniflex™) thermoplastic elastomer (TPE) models that have higher tensile strength that allows them to outperform traditional rubber models.

Santoprene, Wil-Flex is ideal for use with acidic and caustic fluids such as sodium hydroxide, sulfuric or hydrochloric acids. Exhibiting excellent flex life, abrasion resistance, temperature range and durability, Wil-Flex is widely used in the chemical processing, food, pharmaceutical and wastewater industries. Versions of Wil-Flex are available that comply with FDA 21

CFR 177 standards for food and beverage applications. The flex life of Santoprene is generally four times that of Buna in Wilden laboratory tests.

Saniflex is an excellent material for food-processing applications. Made of Hytrel, it exhibits good flex life and excellent abrasion resistance. Hytrel also offers superior sealing or seal energizing due to its low compression-set characteristics. Saniflex versions are available that comply with FDA 21 CFR 177 standards. The flex life of Hytrel is generally twice that of Buna in Wilden laboratory tests.

Wilden offers another style of diaphragm in the Pure-Fuse product. This is an integral piston diaphragm (IPD) that incorporates the outer piston into the TPE material of the diaphragm. This diaphragm was developed specially for the food industry to increase yields and decrease costs when compared to the operational capabilities and costs of rubber/PTFE-laminate IPDs.



Thanks to its unique design that locates the piston within the diaphragm material, the Pure-Fuse Integral Piston Diaphragm (IPD) does not have any product-trap areas or spots where operational abrasion will shorten the diaphragm's service life.

The design of Pure-Fuse diaphragms eliminates the space behind the outer piston where particles and bacteria can hide. They eliminate outer-piston abrasion completely, and they eliminate the possibility of leaking past the outer pistons due to torque decay or improper assembly techniques. Pure-Fuse diaphragm utilize the same shaft and inner-piston hardware as standard Wilden pumps – making upgrades a straightforward exercise.

There is some crossover between Wilden's diaphragms and those offered by competitors, such that Wilden diaphragms can be used on some competitors' pumps. See your local Wilden distributor to find out which brands.

To further optimize diaphragm usage and availability, Wilden has created replacement kits that will allow installation of the Pure-Fuse diaphragm into Murzan pumps, particularly those with 11-inch diaphragms (Medium Chamber) and with 14-inch diaphragms (Large Chamber). This creates an excellent opportunity for end users to see first-hand how Wilden diaphragms can improve food-manufacturing processes.

The kits consist of a pair of Pure-Fuse diaphragms and two thread adapters that connect Wilden diaphragms to the

Murzan shaft. The Murzan inner pistons are also retained. The Wilden Pure-Fuse diaphragm has been an unqualified success in this crossover application.



Many Wilden diaphragms can be compatible for use on competitive models, so much so that Wilden has created Replacement Kits to help simplify in-the-field diaphragm replacement.

2. AIR MOTOR SUPERIORITY: WILDEN AIR MOTOR IS MORE EFFICIENT AND HIGHER PERFORMING THAN MURZAN

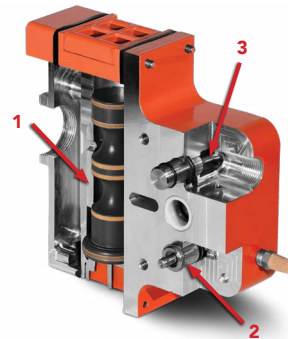
The air motor is the heart of an AODD pump and Wilden has led the field for decades in air-motor design. The motor consists of an air valve, a center block and two air chambers. It is a good practice to have one or more assembled motors in the maintenance shop, ready to be installed into a pump body when that pump's motor needs repair.

The function of the motor is actuated when compressed air is directed to either diaphragm in an alternating rhythm. No matter the operating speed of the pump, the motor must reliably shift at the end of each discharge stroke and then begin the discharge of the opposite diaphragm.

Wilden's Pro-Flo® SHIFT Air Distribution System (ADS) uses an unbalanced spool, shown by arrow number 1 in the picture below, that has two different-sized ends. Compressed air is ported to the small end continually, which drives the spool in the downward direction. Intermittently, the large end is pressurized. When both the large and small ends are pressurized, the greater surface area (greater diameter) of the large end exerts a larger force than that of the small end, resulting in the spool moving in an upward direction. The area

pointed out by arrow 2 is the pilot mechanism that provides the intermittent signal mentioned. It is actuated by the location of the shaft and diaphragm.

The benefit of this design is that the spool cannot be centered in a stall condition by low-speed operation, as can happen with other ADS designs. Another benefit over Murzan, in this case, is that the air valve body is accessible without removing the pump from service. Simply disconnect the air connection and remove the air valve from the center block to observe the condition of the valve while troubleshooting.

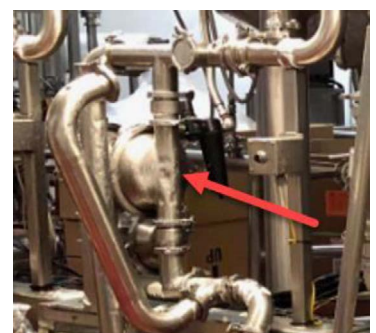


A properly operating Air Distribution System (ADS) is at the heart of an efficient AODD pump and Wilden revolutionized ADS operation with the development and introduction to the market of the Pro-Flo® SHIFT ADS in 2016.

Competitive air valves may also be buried horizontally within the center block housing of the pump, which will require full pump disassembly to repair or replace. These valves perform both piloting and main valve functions and are subject to wear of the O-rings, which leave the pump susceptible to stalling. The picture below shows the Murzan air valve assembly next to a Murzan pump seen in service in Bakersfield, CA. Notice the

dents on the liquid chamber, a feature seen in many Murzan pumps in the field. The dents are thought to be from operators hitting the pump with a mallet to un-center the air valve of a stalled pump. This is not something that is needed with Wilden's Pro-Flo SHIFT ADS.

Another outstanding feature of the Pro-Flo SHIFT air valve is the energy efficiency it provides to the user. It is well known that compressed air is one of the most expensive forms of energy that is used to drive machines. By using less compressed air to do the same work, Wilden offers energy savings to the user.

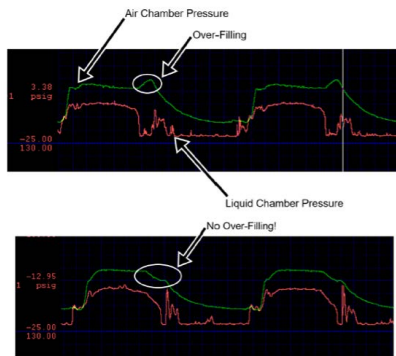


At left, an outdated ADS from a Murzan® pump used in a facility in Bakersfield, CA, features pitting on the liquid chamber, while in the photo at right, the denting indicates that a hammer or mallet has been used on the Murzan pump in an attempt to un-center a stalled air valve.

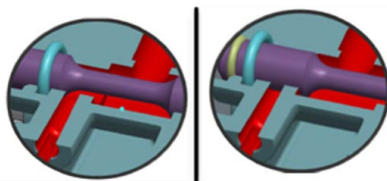
How this is managed is very simple – first, when any AODD pump is operation air enters the air chamber with enough pressure to move the diaphragm against the system’s discharge pressure. The diaphragm moves, displacing fluid. At the end of the stroke, as the diaphragm triggers the air motor to shift, the shaft and diaphragms come to a stop.

No one turns the compressor off, however, and the air chamber is force fed additional compressed air that is not doing any work and will be exhausted to the atmosphere in the next moment. This occurs with all AODD pump brands and it is one of the conditions that had come to be accepted as the nature of the pump. But the Pro-Flo SHIFT is different. Wilden created the air control spool as a way to throttle the compressed air at the end of each stroke – automatically, and using simple analog technology, such that air savings and cost savings are realized on each stroke. The mechanism is labeled by arrow 3 in the air motor picture.

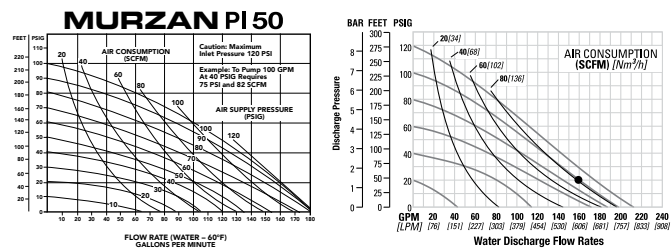
This graphic shows pressure traces from one side of two AODD pumps. The top chart shows a standard AODD pump; green is used to show the driving air pressure and red for fluid pressure. The peak or nose at the end of the stroke is the wasted over-filling of air. The trace on the bottom is for the Pro-Flo SHIFT air motor, here the wasteful “nose” has been eliminated. It may not seem to be much, but this savings accumulates over every stroke, reducing the air consumption of the Pro-Flo SHIFT pump noticeably.



This graphic shows how the air control spool (device) works to allow compressed air into the air chamber unencumbered from the upper right. In this case, the diaphragm is moving to the right. For most of the stroke, the chamber needs to fill quickly to maintain fluid pressure; incoming air is not restricted, shown on the left-hand side. Nearing the end of the stroke, the incoming compressed air is throttled to slow the volume of air being consumed.



From the field, a poultry plant had been using a competitive pump that was tested like-for-like against a Wilden 3" HS Series pump at Wilden’s testing facility in Grand Terrace, CA. In the test, the system’s inlet air pressure and the system discharge pressure were the same as those being used by the competitor’s pump. The results in the chart show that the Pro-Flo SHIFT pump transfers more fluid and uses less air to do it at every data point tested. The Pro-Flo SHIFT ADS also



Duty point 1: 100 GPM v 40 PSI – Murzan uses 82 SCFM, Wilden PS15 uses 57 SCFM
Duty point 2: 160 GPM v 20 PSI – Murzan uses 120 SCFM, Wilden PS15 uses 80 SCFM

This chart illustrates that in side-by-side tests at some discharge pressures, Wilden HS Series AODD pumps outfitted with a Pro-Flo® SHIFT ADS and Pure-Fuse diaphragms can transfer larger volumes of water while requiring significantly less standard cubic feet per minute (scfm) air than a comparable pump model from Murzan®. (Comparative data taken from Murzan® Poultry Processing Pump Brochure.)

provides a higher top-end flow rate. A skeptic might point out that AODD pumps are rarely run at their top-end speed, which is true, but in this test you can see that the Wilden pump can be comfortably run at the competitive pump’s maximum capacity.

3. CLEANABILITY: THE WILDEN DESIGN IS MORE EASILY CLEANED THAN MURZAN

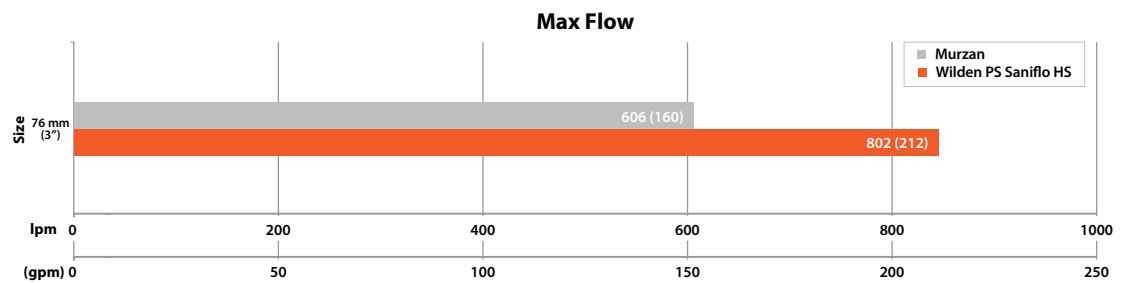
It has been said that any pump is cleanable, provided enough time and chemicals are available. The Wilden HS Series family of pumps was designed to feature clean-in-place (CIP) operation. There are no traps within the pump that will prevent cleaning and residual products from draining. The parts are polished to a 32 Ra (micro-inch) finish. The effort is made to ensure Wilden operators can effectively clean, rinse and restart their processes with minimum downtime.



Competitor
Catch area for product to settle in flow path

Wilden
Product completely drains from flow path

The free-draining flow path in HS Series AODD pumps eliminates product-trap areas and also enables the use of clean-in-place (CIP) techniques that do not require the pump to be taken out of service, which lessens costly downtime.



NOTE: All comparative performance chart data has been gathered from information published by Murzan Pumps & Processing Systems, Norcross, GA, USA



As the chart indicates, Wilden PS Saniflo HS Series AODD pumps are able to produce a higher flow rate than comparable Murzan pumps. This ability to pump more product while consuming less air increases plant productivity.

A comparison of liquid-chamber designs is presented here. An acrylic shield was fabricated to close off the liquid chamber yet permit visibility of the fluid within. The chambers were filled with water and blue food coloring, then they were allowed to gravity drain. The results show the Wilden chamber is more drainable than the Murzan – which retained significant fluid post draining. What effect will that have on Tyson’s process?

In addition to improved draining on the side of Wilden, the Pure-Fuse diaphragm, if utilized, does not need to be removed for cleaning behind the outer piston. The Pure-Fuse design has no areas to trap fluid or particles. The pump is designed for CIP operations, where the Murzan requires clean-out-of-place (COP) procedures.

4. UTILITY INVENTORY. WILDEN HS PUMPS FOR FOOD CONTACT AND INDUSTRIAL UTILITY PUMPS SHARE REPAIR KITS

Some competitors don’t offer utility pumps. They build food-handling equipment, and they also build a specific style of diaphragm pump. Conversely, Wilden builds diaphragm pumps – exclusively – for the food-processing industry, as well as those for mining, chemical processing, paint and coatings, you name it. It is a very good bet that every Tyson facility has some diaphragm pumps that are not involved in food contact. They may be handling cleaning chemicals, waste or any number of non-food applications. All of these pumps need service at some point.

Wilden’s Pro-Flo SHIFT air motor is used across the Wilden product line, meaning the 1.5” aluminum pump used to muck out the loading dock sump uses the same air kit as the 3” HS

pump moving chicken hearts in a processing plant. This reduction in required inventory items on hand also increases operational efficiency.

The diaphragms and valve components used in Wilden HS pumps, while food-grade, can be installed in standard pumps with no need to keep two separate diaphragm inventories on hand, one for food pumps, the other for industrial. Operational efficiency can be increased, leading to cost savings and increased profitability.



For more than 65 years, Wilden has been a leading developer of AODD-pump technology for use in many of the world’s most critical industries, with its Saniflo HS Series models setting the standard in safe, efficient, cost-effective and hygienic operation in food-processing applications.

Conclusion

Wilden has longer-lasting diaphragms made from better materials than any of its competitors. Materials that more consistently manufactured and are tougher, without requiring added reinforcements. Wilden’s patented Pure-Fuse IPD is made for cleanability in the food-processing industry, at the same time offering increased service life over standard diaphragm types by the elimination of outer-piston wear.

Wilden's Pro-Flo SHIFT air motor is the most energy efficient on the market and side-by-side tests have shown that it is higher performing than ADSs found in competitive pumps, particularly Murzan models. Pro-Flo SHIFT is stall-free and won't require hammer blows to restart following a stall. The energy savings in compressed air can be used to add pumping capacity without requiring additional, costly compressor additions.

Finally, Wilden's wetted-path design, along with the Pure-Fuse diaphragm, creates the most cleanable AODD pump available. These means shorter downtimes, and less cleaning chemicals required.

With all of these competitive advantages, Wilden HS Series AODD pumps are a better choice for food-processing applications.

About the Author:

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