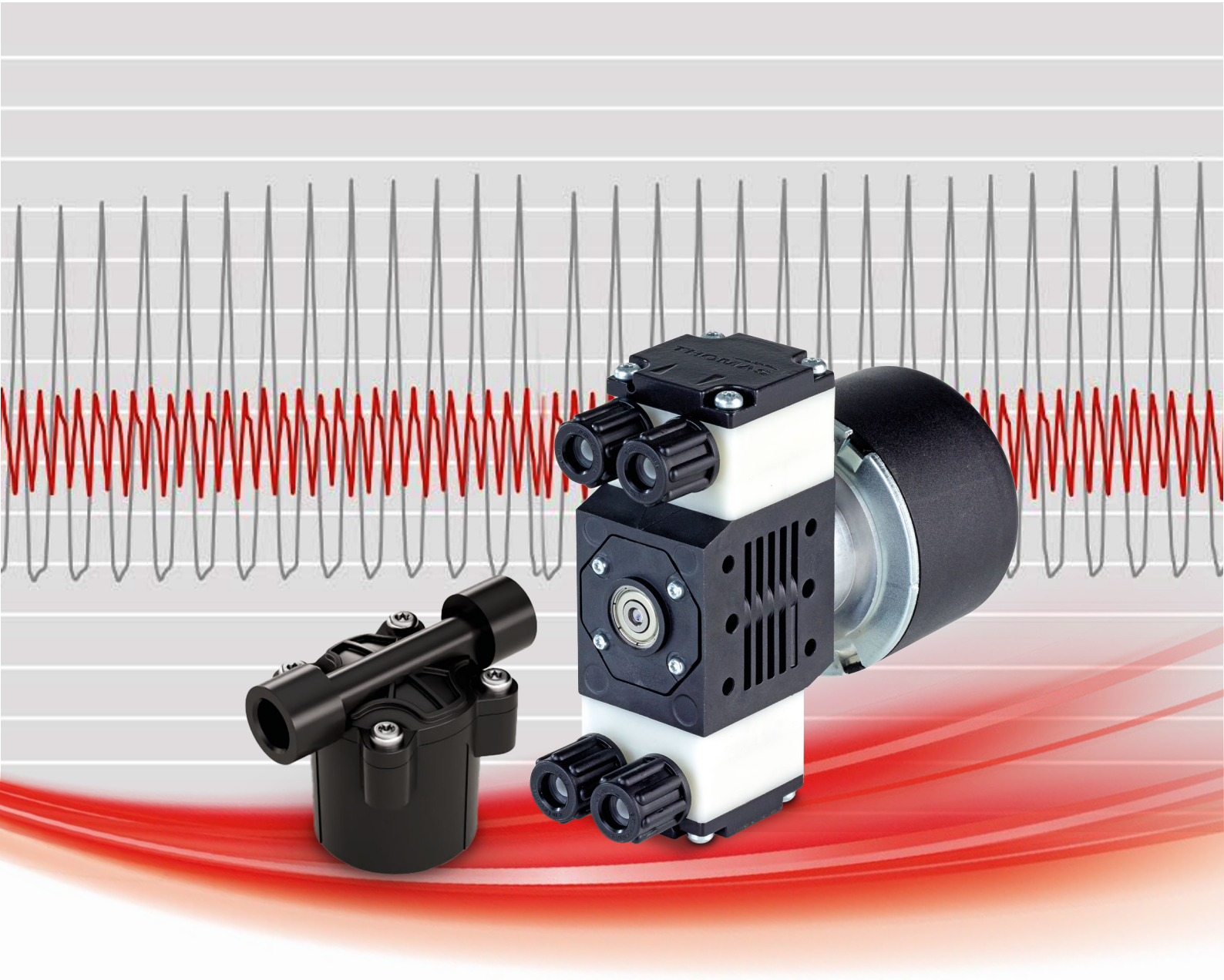
White Paper

THOMAS®
An Ingersoll Rand Business

REDUCING PULSATION

Ensuring Low-Pulsation Transfer in Liquid Diaphragm Pumps



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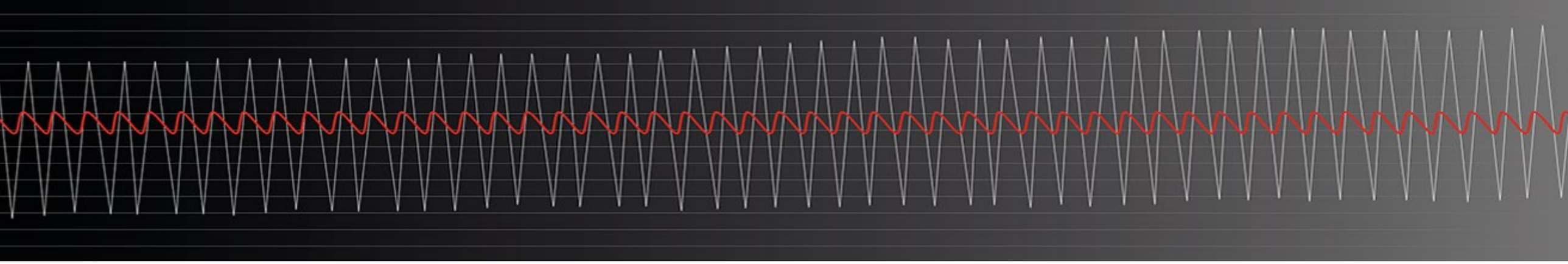
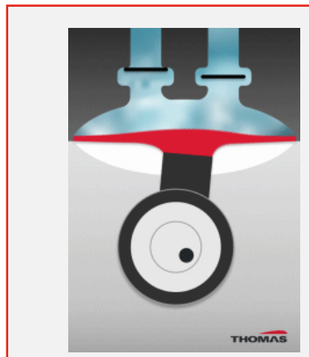


Widely appreciated by users for their numerous advantages including the ability to handle a large variety of fluids (corrosive and abrasive media among them), great suction, dry-running capabilities, high pumping efficiency and durability, **liquid diaphragm pumps are some of the most versatile pumps in the market** and are the perfect match for a wide range of liquid-handling applications. Their relatively low acquisition costs, coupled with easy installation and maintenance, make them some of the most popular pump types used in the world today.

However, the inherent nature of diaphragm technology means that liquid diaphragm pumps are also defined by unwelcome pressure peaks. If equipped with only one diaphragm, such pumps cause pulse waves that may negatively affect the efficiency of the entire system, as well as lead to end-product quality issues in some applications. By using modern design features, Thomas has managed to largely minimize this disadvantage in its liquid diaphragm pump models.

WHAT IS PULSATION AND WHY IT NEEDS TO BE MINIMIZED?



Just like the other positive displacement pump types including peristaltic and piston pumps, liquid diaphragm pumps have their flow rate generated by periodic volume changes inside the pump. The action of an eccentric on the motor shaft moves a flexible diaphragm in the pump head up and down, drawing the medium into the pump chamber on the down stroke and expelling it on the upstroke. Internal valves located within the pump head help control the direction of flow.

The oscillating working principle of liquid diaphragm pumps means that there is no constant liquid flow, but rather sequences of fluid output when the outlet valve is open. Since liquids, unlike gases, cannot be compressed and do not absorb energy but rather transfer it through themselves, higher forces on the pump components are created and hydraulic resistance between the diaphragm chamber and the final load occurs. This makes the volume pulses become pressure pulses travelling all the way to the tubing on the outlet.

While typical for all volumetric pumps, high pressure pulsation is a pump performance feature whose impact needs to be reduced to avoid a number of unwelcome effects on the equipment and the process results. Excessive pulsation increases the wear on the pump components and generates strong vibrations that, in turn, produce higher noise levels. On top of this, it may lead to the formation of small bubbles or foam in the pumped liquid and, in some cases, even damage the transferred medium.

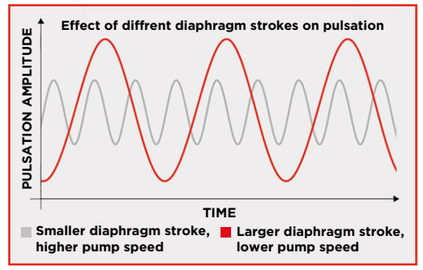
Crucially, pressure peaks are undesired in some applications as they prevent achieving consistently high end-product quality. For example, in inkjet printing – a common application for liquid diaphragm pumps – if too high, pulsation can produce an uneven ink flow that negatively affects the quality of the print output, with the increased energy having the potential for damaging sensitive inks. In this demanding industry, reliance on low-pulsation pumps is the key to gaining commercial success.

REDUCING PULSATION IN LIQUID DIAPHRAGM PUMPS

There are a number of ways of reducing pulsation when liquid diaphragm pumps are used.

1. Reduction of the diaphragm stroke

In order to minimize the pulsation amplitude, the diaphragm stroke can be reduced. This means that a smaller eccentric is used, which will reduce the flow rate as well. To counter the flow rate reduction while maintaining the lower pulsation amplitude, a faster motor turning speed can be applied.

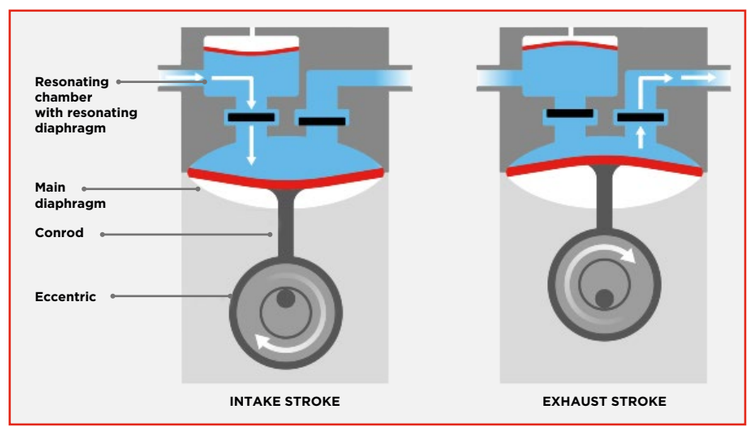


2. Choice of diaphragm material

For different applications, liquid diaphragm pumps can be equipped with different diaphragm materials. Typically, the right choice depends on the medium to be transferred. For chemically aggressive media, diaphragms with an elastomeric base layer and a PTFE coating are often used. Due to the rigid PTFE layer, the overall hardness of the diaphragm is increased. This leads to higher pulsation. On the other hand, materials such as EPDM can help decrease pulsation as the diaphragm is then typically softer.

3. Usage of a resonating diaphragm

A resonating diaphragm is used in our modern liquid diaphragm pumps to smoothen the flow of the pump. It acts as an integrated pulsation damper on the inlet side and also has a positive effect on pulsation on the outlet side.

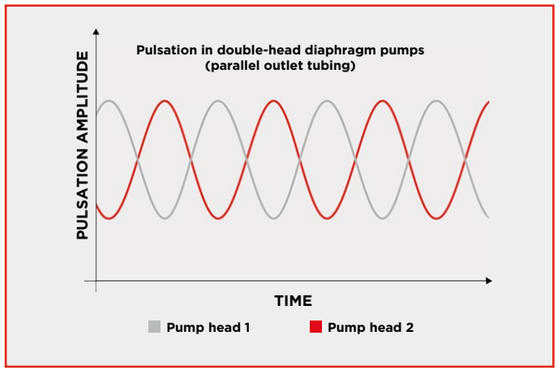


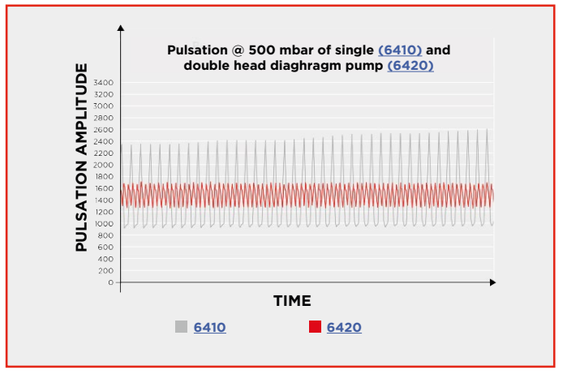
4. Usage of a double-head liquid diaphragm pump

A very common and effective way of reducing pulsation is using liquid diaphragm pumps with two heads. In this option, the two individual heads are mounted in parallel and alternate in pushing out liquid, thus creating overlapping pressure curves.

Single head diaphragm pump (6410) Twin head diaphragm pump (6420)

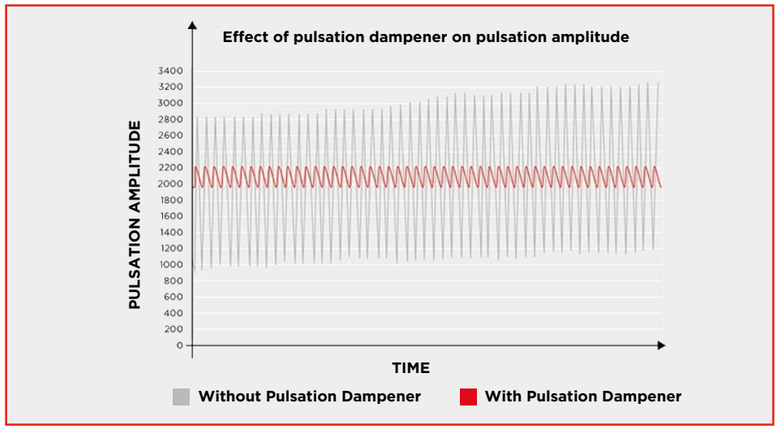
In comparison to a single head diaphragm pump, a similarly constructed double head pump can reduce pulsation by over 70%.



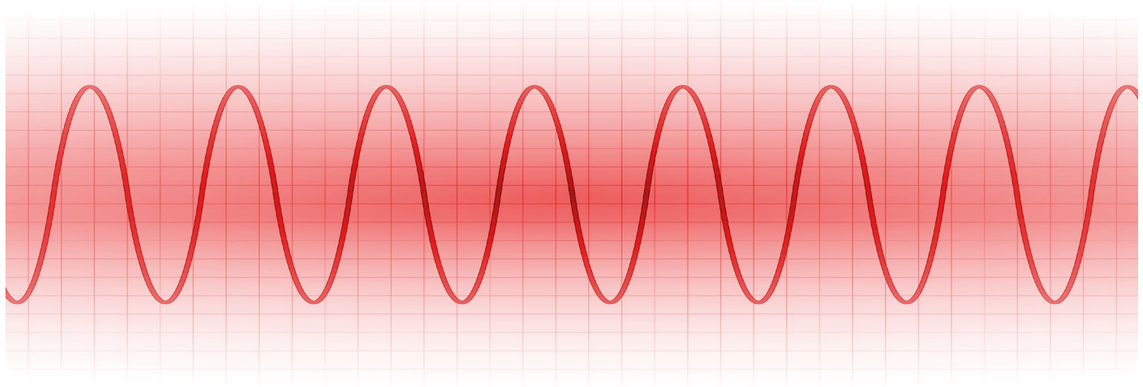


5. Usage of an external pulsation dampener

Such devices are installed on the discharge side of the pump and are designed to absorb the pressure peaks present in the pumped medium with the help of a flexible diaphragm, ensuring significantly smoother fluid flow. **The reduction of pulsation can be more than 90% compared to pump operation without a pulsation dampener.** If necessary, pulsation can be reduced by up to 99% by using additional flow restriction and optimized tubing.



Pulsation dampeners designed by Thomas require no adjustment or maintenance and are defined by the same durability and long lifetime as our diaphragm pumps. They feature small dimensions compared to other available dampeners and use G 1/8" tube connection that is compatible with a large number of connectors. Thomas's pulsation dampeners can also be fitted with an overpressure switch to protect the system. We can customize pulsation dampener technology for the individual pump type and the required application.

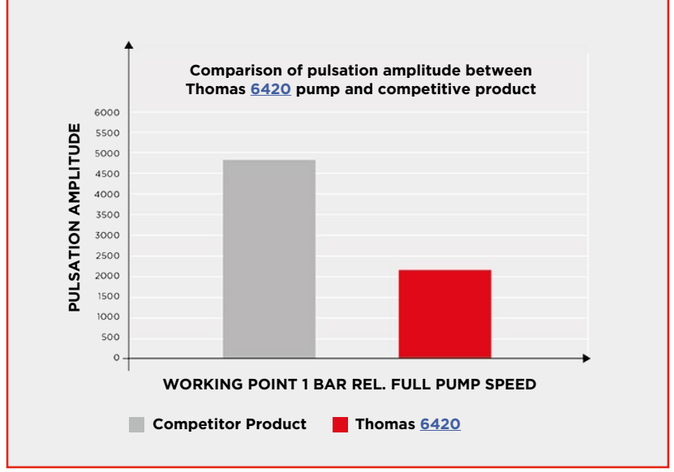


THOMAS' LOW-PULSATION SOLUTIONS FOR GENTLE LIQUID TRANSFER

All other components used in the fluid path have an influence on pulsation. For example, the use of a soft tubing material on the discharge side of the pump helps to reduce pulsation; on the other hand, with harder materials such as PTFE, pulses are transferred without any dampening effect. Also, filters and other restrictions including nozzles have an influence on pulsation. Any restriction after the pump will reduce pulsation, but it will also lead to increased system pressure and a decreased flow rate.

Thomas has been using pulsation-reducing solutions in its liquid diaphragm pumps to ensure even fluid flow in pulsation-sensitive applications. Our **single-head 1210, 6311 and 6410 Series pumps are optimized for limited pulsation due to the use of an additional resonating diaphragm.** Also the usage of optimized elastomeric materials ensures low pulsation.

For applications with a higher requirement on pulsation, Thomas' **6420 Series liquid diaphragm pumps with a capacity of up to 1,800 ml/min and maximum continuous pressure height of up to 10 m H2O stand out through their market-leading smooth transfer of media with minimal pulsation** compared to competition.



Contact us, if you are interested in a customized solution.

TALK TO OUR PRODUCT EXPERT!

Our product manager Michael Buchberger is available to answer your questions and help you find the pump solution you need for your application.

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