PRODUCT RANGE.

Centrifugal pumps, horizontal
with hydrodynamic shaft seal
up to the dry-running magnetic coupling

Centrifugal pumps, vertical
– for dry installations, short design
– for wet installations,
  without bearings in the liquid
– for wet installations,
  with roller bearings independent of product
– with feeder propeller
  for space-saving installation

Centrifugal tank pumps
with inlet from above

Centrifugal pumps, impeller variants
– with semi-open impellers
– with closed impellers
– with torque flow impellers

Hermetic rotary piston pump
– hermetically sealed
– without bearing in the liquid
– low-pulsation
– also suitable for higher viscosities

Downstream seals
for pumps with hydrodynamic relief of the shaft gap
– gland packing
– mechanical seal
– magnetic coupling
– special solution for problem cases
– lip seal

Comprehensive information about each type of pumps is featured in individual product broschures.

MATERIALS.

– all castable and weldable stainless steel qualities
– castable and weldable special alloys
– grey cast iron, rubber lined
– special materials such as titanium, zirconium, SiC etc.
– Plastic (HRK only)

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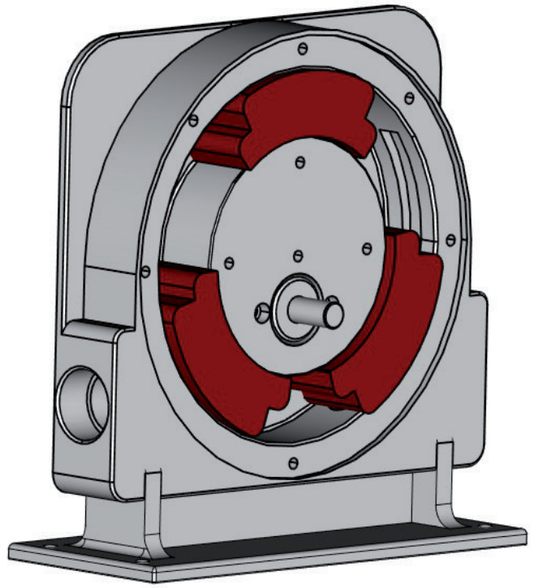
HRK/22_e



BUNGARTZ

HERMETIC
ROTARY
PISTON PUMP

CONTENT

DOUBLY INGENIOUS.

THE HERMETICALLY SEALED ROTARY PISTON PUMP.

The time for creative inventions is ripe more than ever before. There is a lot to do, especially in the engineering sector, as demands for energy efficiency and reduction of emissions continue to rise and rise. New technologies are helping to reduce the burden on the environment while also creating economic benefits.

With the Hermetic Rotary Piston Pump, short HRK, to give it its German initials, we have succeeded in bringing a world first onto the market. This masterpiece not only handles toxic, corrosive and more viscous products with ease. It also has low life-cycle costs.

The HRK is both ingenious and forward-thinking. It is a bridge between the energy-efficient but cost-intensive positive displacement pumps and the hermetically sealed centrifugal and canned motor pumps. It is also intelligent enough to combine the positive qualities of both these types of pump.

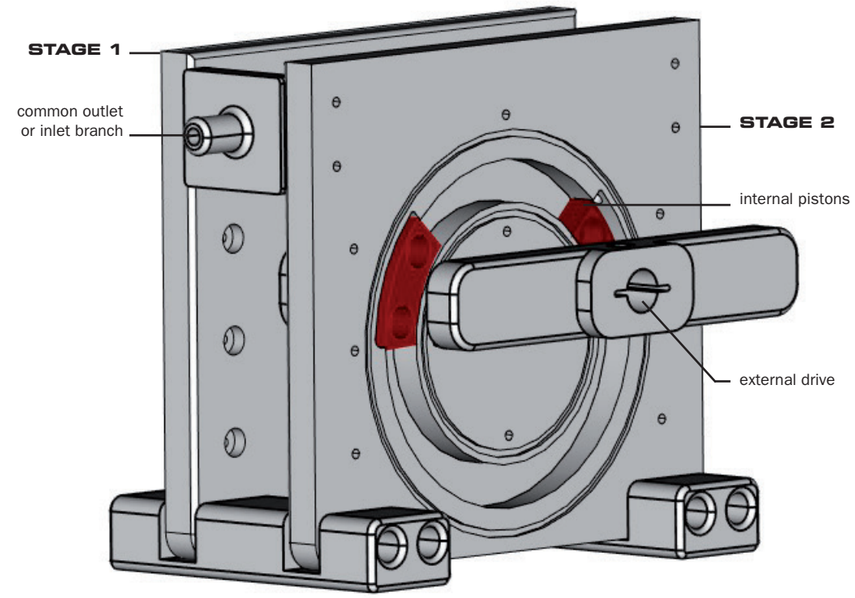


FIG. 1: FUNCTIONAL SHOW MODEL
2-stage version of the HRK

While the sealless centrifugal pumps excel with advantages such as being hermetically sealed, cost-effective, valve-less and low-pulsation,the positive displacement pumps also have their strengths. Their high efficiency, suitability for viscous pumped liquids and low specific speeds are unbeatable plus points.

The HRK is also a rather modest representative of pumps. This is because it works entirely without a shaft leadthrough, bearings in the pumped liquid or valves. Less is definitely more.

On top of which: Only the casing and the pistons come into contact with the product being pumped. Both are made of plastic and are extremely robust.

As a result, the structure of the HRK is as simple as it is effective. The fact that the torque of the outer shaft is transferred to the pistons by magnets only brings advantages. This makes the pump virtually wear-free and requires no maintenance. The perfect solution!

SPECIAL FEATURES.

The HRK incurs low life-cycle costs.

The HRK pumps
- toxic media
- corrosive media
- more viscous media

The HRK enables
- emptying of residues
- use in ATEX areas
- CIP cleaning

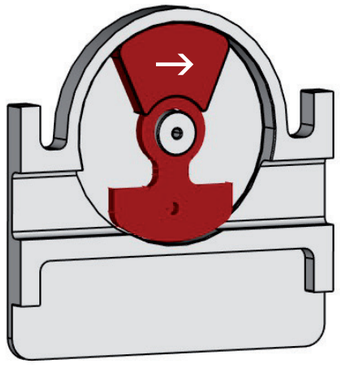


FIG. 2 (0°)

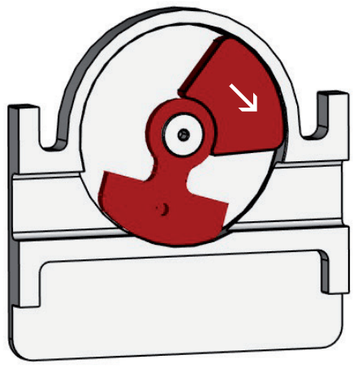


FIG. 3 (45°)

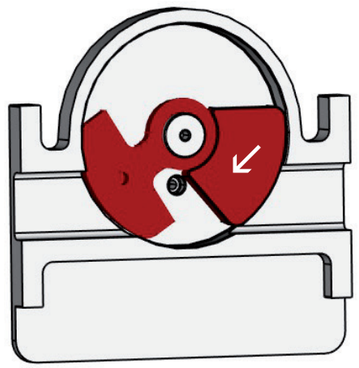


FIG. 4 (90°)

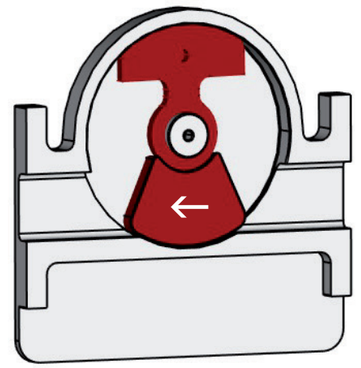


FIG. 5 (180°)

SYNCHRONIZED.

THE OPERATING PRINCIPLES OF THE HRK.

Only good things can come from components that complement each other and work well together. The HRK has two pistons that are in unison. Their continuous rotation has a positive effect: little pulsation.

But how exactly does the HRK fulfill its duty? The drive shaft is positioned eccentrically to the annular space of the displacer. This periodically changes the pumping spaces between the double pistons. These two pistons, located in the circular annular space, are coupled via a drive pulley in such a way that the contact points are always opposite each other. The space between them periodically increases and decreases, respectively, with the rotation of the drive pulley. That sounds like successful teamwork.

The results are impressive. Two suction and two pumping strokes can be achieved per revolution and per stage. The pumping volume per revolution corresponds to the maximum annulus volume that has been passed through. This pump design uses a magnetic guide through the wall of the pump casing to act as a simple “gear”. Magnets on both sides of the pistons and on the drive pulley do two jobs at once.

They transmit the torque and also take care of the kinematic connection. Which means: The drive on both sides is completely contactless and keeps the pistons in suspension.

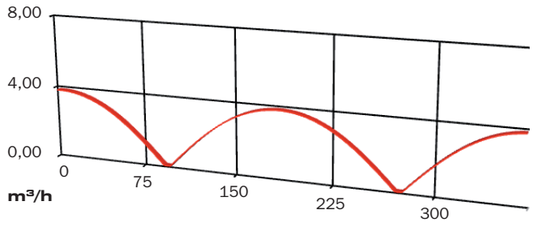
Inlet and outlet operate without valves and are designed as simple bores. They are reliably controlled by the pistons.

The HRK is proven to be very flexible. Any number of stages can be operated on one shaft in parallel or in series. This increases the differential pressures. Also: Pumping takes place with low pulsation, as if lubricated.

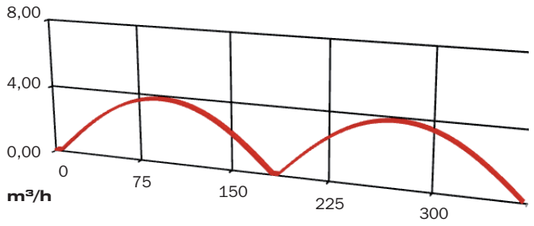
Figure 1 (page 3) shows a 2-stage, parallel-operated and phase-shifted arrangement with four strokes per shaft revolution. The simple functional show model in Figures 2 to 5 presents a 1-stage design with two strokes per revolution. These illustrations clearly show the various work steps over a rotation angle of 180°. Although only 1-stage operation is used, the pump surprisingly performs two suction and pressure strokes per revolution. And this corresponds to the pumping behavior of a rotary piston pump.

FUNCTIONAL SHOW MODEL
Pump in 1-stage design,
two strokes per revolution

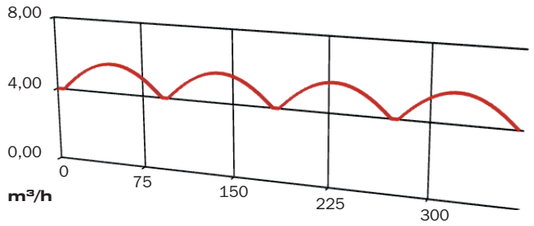
The four positions show the motion sequence of a half revolution of the shaft, which corresponds to one stroke.



FLOW RATE STAGE I
Angle of rotation (over one full revolution)



FLOW RATE STAGE II
Angle of rotation (over one full revolution)



FLOW RATE STAGE I AND STAGE II
Angle of rotation (over one full revolution)

CLEVERLY COMBINED.

THE PHASE-SHIFTED STAGE ARRANGEMENT.

The pumping behavior of the technologically revolutionary Hermetic Rotary Piston Pump are as refined as they are impressive. The 2-stage version is the standard. The stages are controlled with a phase shift of 90°. This allows four suction and four pressure strokes to be achieved – per revolution. The volume flow pulsation has proven to be extremely low. This can be easily seen in the diagram on the top right.

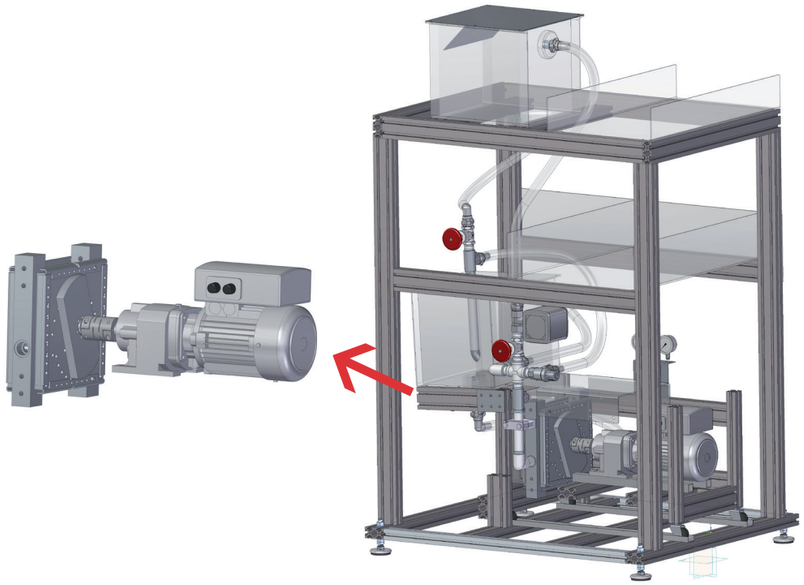
The multi-stage version implements a modular design. The bearing is attached here regardless of the stages. The results are convincing. The reason is that this design allows not only two or three stages to be mounted on one shaft, but four or possibly even more. There are only two bearing points. Stages and drive units are repeated. The practical result: The variety of parts is reduced.

GOALS.

- low-pulsation pumping thanks to the mechanical and hydraulic operating principle of the applied kinematics
- emission-free, hermetic design, i.e. without shaft opening through the use of magnetic coupling
- high efficiency of a positive displacement pump
- high availability and reliability due to the hermetic and valve-less design, with all drive, sealing and bearing units located outside the product chamber
- minimization of the number of parts

BENEFITS.

- **less expensive**
  > than the classic, hermetically sealed positive displacement pump
- **low pulsation**
  > standard version with four strokes per revolution
- **hermetically sealed**
  > no seal that is subject to wear
- **100 % intrinsically and overpressure safe**
- **no valves and no dead spaces**
  > provides a basis for later use in the pharmaceutical and food industries (CIP cleaning)
- **ATEX Zone 0-capable**
  > in combination with conductive plastics
- **no wear**
  > no bearings in the liquid and hydrodynamic piston guidance
- **corrosion-resistant**
  > all parts made of plastic
- **higher efficiency**
  > also at low, specific speeds and high viscosity
- **low shear**
  > due to low speed
- **good suction capacity**
  > can be used reliably even with higher suction line losses
- **zero flow rate safe**
  > optimally suited for emptying of residues



DEMONSTRATION STAND OF THE 2-STAGE PUMP with up to 1,600 strokes per minute

IN DEMAND EVERYWHERE.

THE MANY POSSIBLE APPLICATIONS.

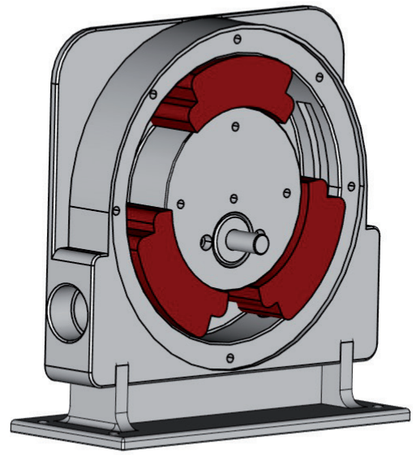
Both versions of the HRK are suitable for a wide range of important applications.

2-STAGE BASIC VERSION WITH FOUR STROKES PER REVOLUTION.

The basic version of the HRK essentially combines the standard applications of a normal-priming, hermetically sealed centrifugal pump with the advantages of the positive displacement pump. The goal is to achieve initial flow rates of up to 20 m^3/h and delivery pressures of up to 10 bar – with up to 1,600 strokes per minute.

APPLICATIONS.

- pumping of chemical liquids such as hydrochloric acid, sulfuric acid, nitric acid
- pumping of toxic and corrosive liquids
- pumping of more viscous liquids
- pumping of shear sensitive substances
- pumping explosive media
- pumping of pharmaceutical products with suitability for 100 % CIP (outlook)
- emptying residues from systems such as containers and tankers
- mixing of material flows at a defined volume flow ratio through the parallel connection of several stages
- simple filling processes with defined volume flow



1-STAGE PUMP
with up to 1.200 strokes per minute

1-STAGE VERSION WITH TWO TO THREE STROKES PER REVOLUTION.

The 1-stage design follows the pumping principle of the rotary piston pump with segmental piston. However, unlike the latter, the ingenious HRK does not require a mechanical seal, synchronizing gear, or shaft leadthrough. The result: It is maintenance-free and more suitable for CIP cleaning, due to the fact that it is absolutely free of dead space and gaps.

The comparatively simple design of the 1-stage version comes with a bearing integrated in the casing. This makes the pump much more compact. Its casing is made of stainless steel.

The illustration shows the 1-stage version with three segmental pistons. The pump therefore already achieves three strokes per revolution. This is comparable to the pumping behavior of a diaphragm pump with three phase-shifted stages, also called a triplex pump. But here, one step is enough. Incidentally, this design can also be easily coupled with another phase-shifted stage. This results in an increase to six strokes per revolution.

APPLICATIONS.

- pumping of more viscous liquids
- pumping of liquid media with soft solids
- simple dosing tasks such as filling
- complete emptying
- pumping of CIP liquids (rinsing pump)

HERMETIC ROTARY PISTON PUMP
DESIGN PROPERTIES

PROPERTIES	APPLICABLE YES / NO	METHOD OF IMPLEMENTATION	COMMENTS / OUTLOOK
hermetically sealed	yes	The pump's pistons are driven through the wall of the rotationally symmetrical casing. There are no mechanical transmission elements, no lead-through through the casing wall.	
high leakage safety	yes	There are only two static round sealing rings for mechanical sealing.	There are plans to permanently weld the casing parts in the future. This means that the static O-ring seals that are still present are no longer nec-essary.
no bearings in the pumped liquid	yes	Only the hydrodynamically sliding pistons are located in the pumping chamber. The roller bearings are installed in bearing units on the outside and are easily accessible, regardless of the pumped medium.	
no sealing fluid required	yes	There is no shaft leadthrough. The pistons are located in the pumping chamber and slide hydrodynamically with the pumped medium flowing around them.	
no shaft in the pumped liquid	yes	The shaft is outside the pumping chamber and has no contact with the pumping medium.	
no valves	yes	Pumping is carried out continuously in one direction. This is controlled via the segmental pistons and corresponding control slots at the inlet and outlet of the casing.	
maintenance-free	yes	The roller bearings do not require any maintenance due to the low speed of max. 500 rpm. The pistons move by hydrodynam-ically sliding through the pumped liquid. The pump is therefore completely maintenance-free.	
wear-free	yes	The pump is wear-free when operated as intended, i.e. with liquid filling and without solids, as the pistons are magnetically driven on both sides. As a result, they float almost freely along the axis and are surrounded by liquid on all sides. The roller bearing is also not subject to wear at the low speed of only 400 rpm.	

HERMETIC ROTARY PISTON PUMP
MEDIA-RELATED PROPERTIES

PROPERTIES	APPLICABLE YES / NO	METHOD OF IMPLEMENTATION	COMMENTS / OUTLOOK
suitable for corrosive liquids	yes	In the standard version, the pump is made of corrosionresistant plastics such as PVDF.	A metallic version is also possible. The eddy current losses are negligible due to the low pump speed.
suitable for viscous liquids	yes	The pistons rotate freely in the liquid. Small speeds of up to 500 rpm are used due to the hydrostatic pressure increase, which means that the flow losses remain low even at high viscosities. Currently, the pump has been tested up to 4000 cp.	Higher viscosities are also possible at reduced speed.
suitable for liquids with gas components	yes	The pump has a continuous pumping action. The single piston has no zero crossing and moves continuously. Only the relative speed between the pistons changes periodically. As a result, the pump achieves very good suction. Forced pumping allows liquids with a high gas content to be pumped. Emptying of residues from containers is possible.	The pump is not self-priming, but can empty containers completely.
suitable for liquid with soft solids	yes	The large cross-sections and the valveless design enable the pumping of larger, soft solids.	
suitable for liquid with hard solids	no	In the present hermetic design, the pump is targeted at hazardous liquids or is intended to provide a maintenance-free chemical pump that requires no sealing or flushing liquids and little maintenance.	A metallic version is also planned for development. It could then also be used for harder solids.
suitable for shear sensitive liquids	yes	The medium flows through a valve-less free cross-section. The gap cross-sections are negligible compared to the pumping chambers. The speed is low.	Speed (100 – 500 rpm)
suitable for CIP cleaning, and for pumping CIP liquids	yes	The simple rotationally symmetrical ring casing without any valves makes the pump ideal for the CIP concept. However, the present variant is primarily intended for chemical use.	A variant is planned whose casing parts are seamlessly welded. In this version, the pump will be completely free of dead space and the flow will run completely through it. This variant can then be sterilized and requires no maintenance.

HERMETIC ROTARY PISTON PUMP
INTRINSIC SAFETY

PROPERTIES	APPLICABLE YES / NO	METHOD OF IMPLEMENTATION	COMMENTS / OUTLOOK
suitable for pumping from tanks classified under ATEX zone 0	yes	The casing is made of an electrically conductive plastic for zone 0 applications. This variant is therefore suitable for pumping and emptying of residues from a zone 0 tank.	Ensure that the pump does not start up completely dry.
physical overpressure protection via a magnetic drive	yes	Due to the magnetic torque transmission, the pump cannot be destroyed through a malfunction on the discharge side. At the moment of overload, the magnetic coupling over-revs. The connection between suction and pressure side becomes permeable.	There are only the pistons between the suction and pressure lines, no valves. The pump does not need to be dismantled in the event of overrevving.
suitable for zero flow / for emptying of residues	yes	The pistons move in a hydrodynamic lubricating film similar to a slide bearing. This is also ensured when the chamber on the suction side is completely emptied. As the pump also works with high gas components, it is possible to completely empty tanks of residues.	A complete emptying of the residue is permitted when using electrically dissipative plastics. Ensure that the pressure line does not run dry.
no heating during lack of liquid	yes	The pump rotates at a low speed, with the pistons sliding hydrodynamically in the liquid. At the low speed, only low eddy current losses are generated even when using a metallic casing material. No eddy current losses occur when using plastic as the casing material.	The pressure line must be filled with liquid, as wear will occur on the piston and casing if it runs completely dry. Complete emptying by the pump may take place on the suction side.