ROTATING RIGHT

SEEPEX USER ADVANTAGES

User Advantages

A Complete Explanation

The **seepex** Innovation

The Goal

The justification for our entrance into progressive cavity pump manufacturing was the need for the development of pumps that would last longer, be less expensive on the initial purchase and be easier to maintain and service.

The Solution

seepex presented its solutions to these problems to the users of progressive cavity pumps, but in the beginning, some people did not understand the exact nature of the solutions.

In a time where everything seemingly needs to be accelerated, our solution came in the manner of speed reduction. In 1972, we introduced a method to maintain pump capacities and pressure capabilities, while reducing the actual surface velocity of the rotor.

These solutions came as a result of innovative thinking supported by basic engineering practices and attention to detail.

Longer Sealing Line

The reduced sliding velocity of the rotor combines with a longer sealing line to increase the life of the rotor and stator by 30 - 50%.

Less Down Time

Replacement costs, operating costs and production interruptions were reduced.

6L-Geometry

The **seepex** innovation was readily accepted. At the time this document was printed over 50,000 **seepex** pumps with the **6L**-geometry have been installed throughout the world.

The pages that follow present some of the technical features that have led to this extraordinary success.

The Design Concept

Thoughtfully Conceived

We changed the entire design of progressive cavity pumps through improvement of the most important components (rotor, stator, universal joints), we revolutionized the external construction method (block design) and dramatically improved the serviceability by adding quick disconnect components (plug-in shaft connections).

Result: Cost Efficiency

Simply, the **6L**-geometry allows the use of a smaller diameter rotor and a longer sealing line which reduces wear and improves efficiency.

The resultant decrease in velocities provides an increase in component life of 30 - 50%.

Page 4 + 5

Reduced Thrust Loads

The **6L**-geometry reduces thrust loads and the **seepex** 'block' pump design eliminates certain, redundant drive components. These two **seepex** innovations result in a more compact pump unit, so it can be installed into smaller spaces and still allow plenty of room for easy maintenance.

Smaller Space Requirements

An extra benefit from this design innovation is a lower initial cost.

Page 6 + 7

Service Friendly

The plug-in shaft connection. This **seepex** innovation allows for a pump to be easily disassembled, for routine maintenance or field modifications, in a fraction of the time alloted for most other pumps.

Page 8

Protected Joints

The universal joints consist of only a few, easily maintained components. The coupling rod bushings and guide bushings are specially hardened metals and they are positively sealed with a liquid and gas tight elastomeric cover. We offer an optional universal joint sleeve protection made of stainless steel that carries a 10,000 hour operating guarantee.

Page 9

Improved Rotor Surface Finish

seepex takes great care to produce rotors with extremly smooth surface finishes and high quality surface coatings. This helps to produce pumps with higher efficiencies, longer component life and smoother operating characteristics.

Page 10

Individual Stator Design

seepex stators are molded to size, specifically for each pump and pressure design. This design ensures a reliable seal, integral with the stator elastomer; and exact geometry without the variations common in cut-to-size stators. Stators are available in a wide variety of elastomers.

Page 11

Extended Stator Life

seepex offers an adjustable stator retensioning device that dramatically increases stator life. It easily and evenly adjusts without deforming the stator sealing line geometry.

Page 12

No Dry Running

seepex Dry Running Protection. It positively protects against the breakdown of a progressive cavity pump and works independently of the type of products being pumped. A sensor monitors the critical temperature between rotor and stator. At the critical point, a remote controller shuts down the pump or the process to avoid serious damage. **seepex** Patent.

Page 13

Detailed explanations of each of these features are on the following pages. Please examine them in depth.

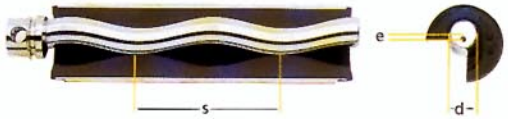
Technical Presentation
The Design Features Unique To **seepex** Progressive Cavity Pumps

The seepex 6L-Geometry

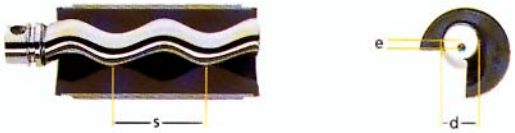
This rotor and stator configuration was developed in 1972 and has proven itself, globally, with its definitive advantages in tens of thousands of applications.

Comparison:

6L-Geometry

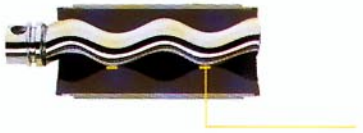


Conventional Geometry



Increased Service Life Due to Reduced Sliding Velocities and a Longer Sealing Line

Sealing line 6L-geometry



Sealing line conventional geometry

The theoretical conveying capacity is calculated as follows:

$Q_{th} = 4e \cdot d \cdot 2s \cdot n$

Q_{th} (theoretical flow rate) is a function of 'e' (the eccentricity of the rotor), 'd' (the rotor diameter), 's' (the pitch length of the rotor helix) and 'n' (the pump speed).

Comparison

In the illustrations, Q_{th} is identical since the smaller rotor eccentric and smaller rotor diameter are compensated by the longer pitch: At the same speed, both units produce the same theoretical flow rate.

Speed and Capacity Identical

The service life of rotor and stator is determined by the product being pumped and the rotational speed of the rotor – more precisely, the sliding velocity 'V' of the rotor.

$V_{max} = \pi \cdot n \cdot (d + 4e)$

Increased Service Life

*In comparison to the conventional rotor and stator configuration, the **seepex** **6L**-geometry has a sliding velocity that is 20% lower, at the same rpm, due to the smaller rotor diameter and reduced eccentricity.*

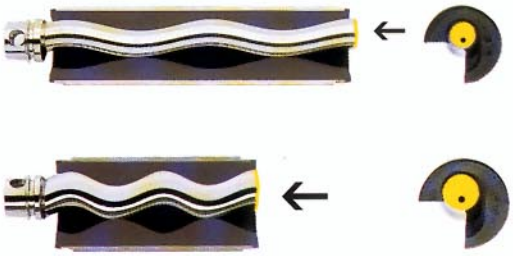
This velocity reduction has a considerable impact on the longevity of the rotor and stator components, the main wearing items in a progressive cavity pump.

Stability in Pressure and Flow

*The longer sealing line of the **6L**-geometry also maintains a constant pressure and flow for longer periods in case of advanced wear.*

The **6L**-Geometry

Reduced Thrust Loads on Universal Joints and Bearings

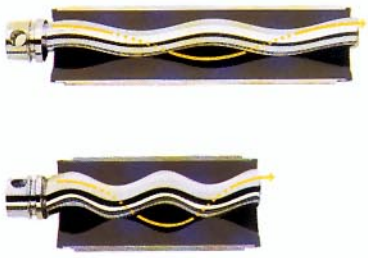


Reduced Thrust Load

Reduced thrust loads on the joints and the bearings are an additional advantage of the smaller rotor cross section.

*With the reduced rotor diameter and the resultant smaller eccentricity, the **6L** rotor cross section is significantly smaller than the conventional geometry. Since thrust load is a direct function of the system pressure acting against the rotor cross section, a conventional rotor design will transmit about 50% more thrust load on the universal joints and bearings.*

Smooth, Even Performance



Improved Flow

The longer configuration of rotor and stator provides a more 'straightline' flow through the pump. This reduces vibration, turbulence, shear rates and pulsations.

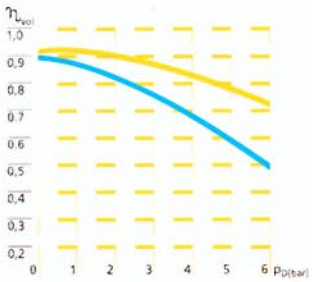
Improved Efficiency

Verified in independent tests performed by a technical university.

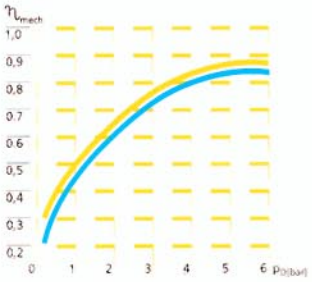
seepex 6L-Geometry

Conventional Geometry

n = 200 min^{-1}

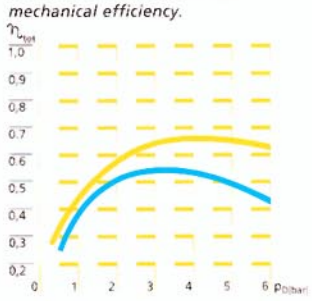


*The longer sealing line of the **6L**-geometry with its improved sealing capabilities dramatically improves volumetric efficiencies. This becomes especially important in those applications that are in the lower speed or upper pressure ranges.*



The longer sealing line between rotor and stator increases the frictional area at their interface, however, the reduction in rotor diameter results in a lower frictional moment which in turn improves the mechanical efficiency.

Improved total efficiency due to better volumetric and mechanical efficiency.



*Both volumetric and mechanical efficiency are important determinants, since they are combined to calculate total efficiency. To this point, **6L**-geometry has a much improved total efficiency over conventional designs.*

The Block Pump Design

Concurrent with the development of the **seepex 6L**-geometry, due to the lower thrust load associated with this design, was the development of the space saving 'block' pump concept.

This revolutionary, but proven, innovation has now replaced conventional configurations. Over 50,000 'block' pumps have since been installed.

Space Saving Installation

- *Short, compact design*
- *More room for pump maintenance*

Service Friendly

- *Plug-in shaft feature allows easy separation of the drive from the pump*
- *Quick replacement of the worn wetted rotating parts*
- *Separate seal casing allows the fitting of virtually all types of shaft seal variations*

Fewer Components

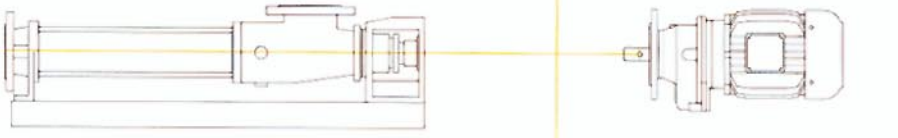
- *No pump bearing assembly, eliminating the need for 'V' belt drives, motor bases, couplings and safety guards*
- *Reduced total unit weight*

Less Expensive

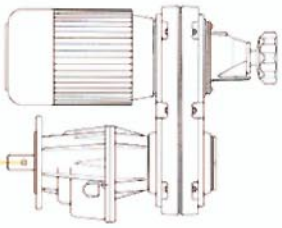
- *The base plate design is independent of the drive type*
- *Combined with the **6L**-geometry, the 'block' construction offers considerable savings over previous designs*

Standardized Drive Components

*The 'block' pump design was developed in collaboration with several major manufacturers of various power transmission devices, so that their standard units could be reliably mated to the **seepex** pumping assembly.*

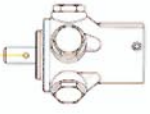


seepex pump range **BN** with baseplate



Mechanical variable speed drives

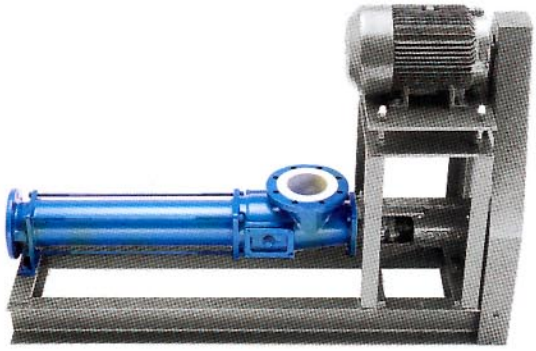
Gear reducers and gearmotors



Hydraulic motors

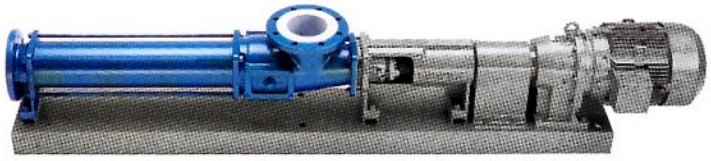
Conventional Configuration 1

seepex range **NS** pump with free bare shaft, mounted on a rigid channel-type base with piggy-back motor, belt drive and protective belt guards



Conventional Configuration 2

seepex range **NS** pump with free bare shaft, mounted on a rigid channel-type base with gearmotor, flexible coupling and safety guard



The Innovative 'Block' Pump Configuration

seepex range **BN** pump with direct connected gear-motor mounted on a rigid channel-type base

Service Friendly Components

seepex range **BN** pump with lantern removed

Rotating unit

seepex stator

The Plug-In Shaft Connection

Between the shaft seal and the bearing assembly or drive assembly, there is a plug-in shaft connection, which greatly simplifies pump disassembly and maintenance.

For example:

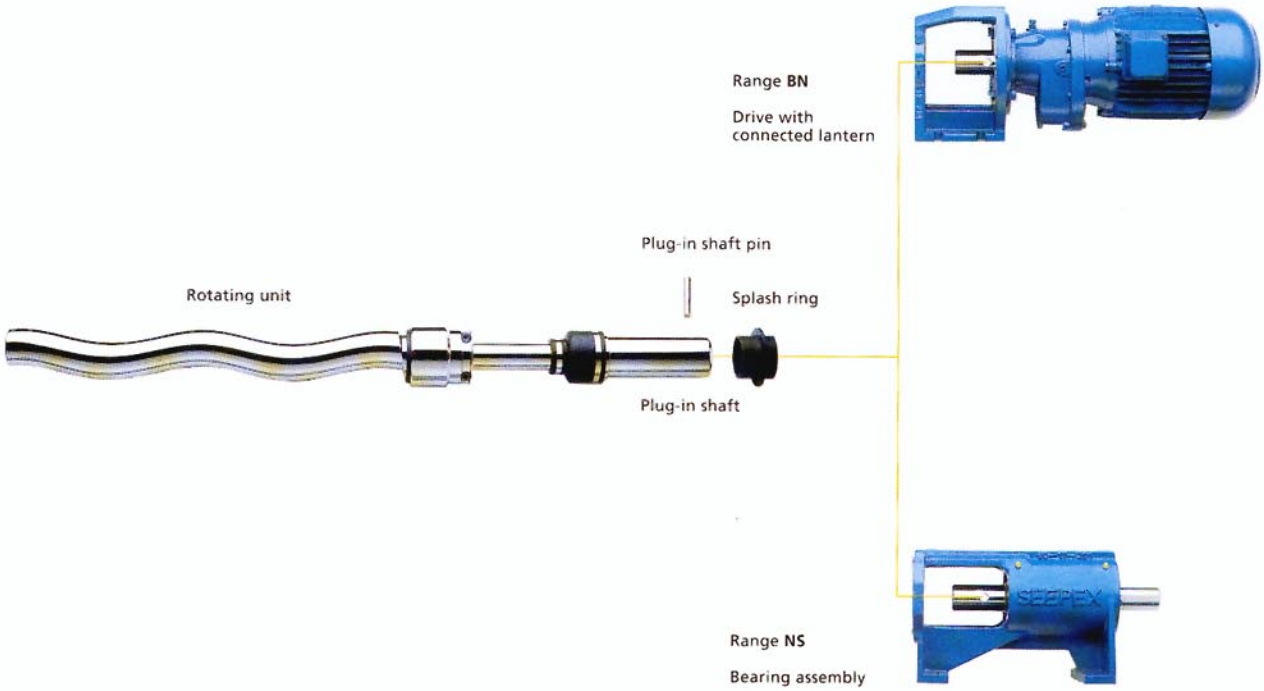
- *Replacement of rotor or universal joints*
- *Replacement of worn drive shafts*
- *Conversions from gland packing to mechanical seals*
- *Replacement of mechanical seals or components*

Quick Conversion or Replacement

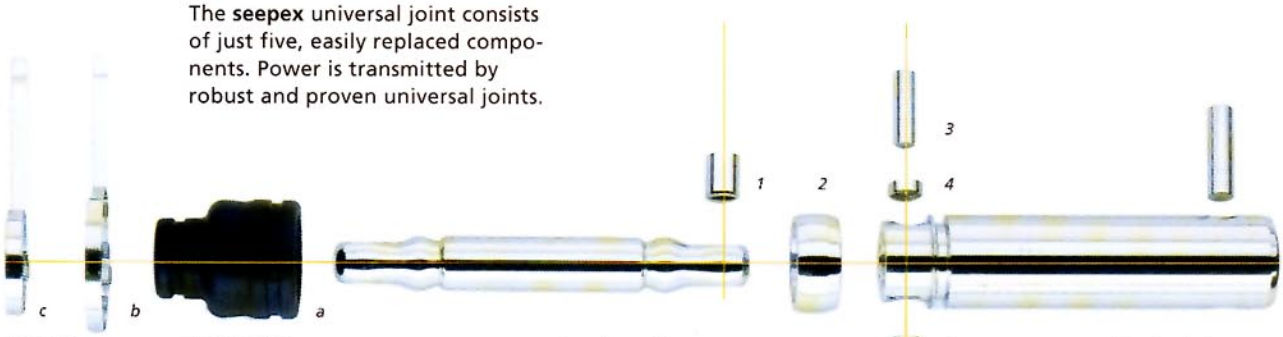
All wetted rotating parts can be removed as a single 'rotating unit'. All that is required is to move the splash ring forward on the plug-in shaft and push out the plug-in-shaft pin. The plug-in shaft functions as a low cost replaceable item, but without the 'O' rings or run out problems inherent with shaft sleeves.

With this configuration, the time consuming disassembly of the bearings or drive components is not necessary, as is common with other designs.

Also, the plug-in shaft design makes replacement of worn rotating parts quick and easy.



The **seepex** universal joint consists of just five, easily replaced components. Power is transmitted by robust and proven universal joints.



Joint seal

a Universal joint sleeve
b Large holding band
c Small holding band

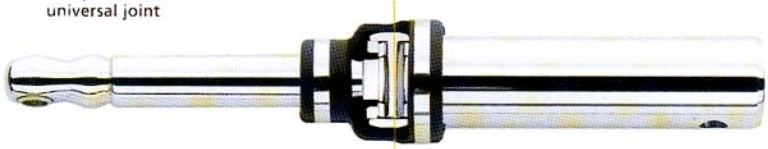
Components

1 Coupling rod bush
2 Retaining sleeve
3 Coupling rod pin
4 Guide bush
5 Guide bush

Coupling rod

Plug-in shaft

Complete assembled universal joint



Improved NPSHR

To ensure the concentricity of the plug-in shaft and accommodate the eccentric motion of the rotor, it is necessary, in progressive cavity pumps, to include an universal joint on the rotor and the plug-in shaft, with a coupling rod that transmits the power from the plug-in shaft to the rotor.

The universal joint is streamlined to reduce turbulence in the suction casing and reduce the NPSHR.

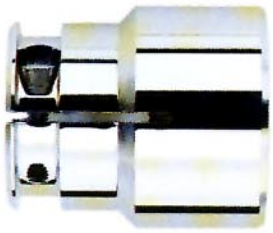
Low Component Wear

The **seepex** *universal joint consists of wear resistant, hardened components that can be easily replaced. Each joint consists of a coupling rod bush, two guide bushes and a coupling rod pin. The joint components are positively secured by a retaining sleeve on the rotor head, plug-in shaft head or drive shaft head.*

Wearing Components are Replaceable

The coupling rod bush is press fitted into the coupling rod. This bush has an internal oval shape and is rounded at the top and bottom, to accommodate the eccentric action movement of the rotor.

These parts are easy and inexpensive to replace. **seepex** *pumps include this feature, as it is crucial to the* **seepex** *concept of customer service.*



Universal joint sleeve protection made of stainless steel

Totally Sealed, Flexible Joint Cover

The assembled universal joint is filled with a specially formulated grease and covered with an elastomeric universal sleeve.

The universal joint sleeve is fastened on each end with a metal holding band.

Liquid Tight Construction for Continuous Operations

The universal joint is positively sealed to protect against the penetration of the nonlubricating or abrasive liquids which are often pumped. This joint cover has proven to be gas and liquid tight in the most severe, continuous operations. This performance cannot be achieved with dynamically loaded 'O' rings or lip seals on the coupling rod.

Joint Protection for High Pressure Conditions

The standard joint construction, described above, can be used in applications where the fluid pressure on the universal joint does not exceed 45 psig; 3 bars.

When there is a high fluid pressure in the suction casing (> 45 to ≤ 175 psig; > 3 to ≤ 12 bars), due to high suction pressure or reverse rotation of the pump (common on suction lift applications), grease fittings are attached to the coupling rod. Additional grease can be added to hydraulically balance the joint cover and protect it from collapsing.

10,000 Hour Guarantee

To protect the elastomeric universal joint sleeve from being cut by large pieces of tramp metal, hard plastic, wood or glass, a metal universal joint protector is offered as an option. Universal joints with this protector, when installed into waste water treatment applications, carry an automatic 10,000 hour operating guarantee.

seepex demands the highest performance from its rotors. This is only possible by providing the highest quality rotor surface.

The most modern methods are used to machine, polish, harden and coat the rotor. In this way, we can ensure the best rotor surface possible for each application.

High Standards

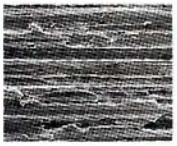
The smoothness of the rotor surface affects its longevity. Improper machining produces microscopic mountains and valleys with only the mountain peaks contacting the stator. These rough surfaces will wear rapidly, due to the reduced contact area, and certain metals, will be subject to increased likelihood of failure as corrosive compounds collect in the microscopic valleys. Improper machining can adversely affect the rated strength and hardness of the material, as well.

Benefits of high quality rotor surfaces:

- *Reduced starting and running torques*
- *Improved hydraulic and mechanical efficiencies*
- *Smoother operation*
- *Increased service life*

Surface roughness charts and photographs from a scanning electron microscope of different rotor surface cross sections (1000 : 1).

Rotor surface, machine finish



Rotor surface, ground finish

seepex standard finish

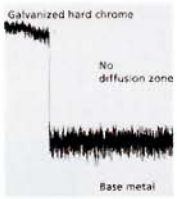
Optimum Service Life

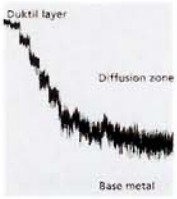
For applications on abrasive liquids, surface coatings can be applied to substantially increase rotor service life.

seepex *is able to provide a very hard, superior chromium coating with the Duktil-coating technique. By applying the Duktil-coating, increased advantages can be realized over standard hard chrome plating.*

This new, electrolytic procedure produces a fissure-free, non-porous coating with a hardness of 1,250 Vickers. This material fuses deep into the base metal, so that it can not lift or peel, as is common with standard chrome, that has a hardness of only 600 Vickers.

The diagram below clearly shows the boundary layer between the galvanically applied chrome plating (top) and the base metal (below), with no diffusion zone. When highly stressed, large particles of chrome can peel away from the base metal.





This diagram shows the deep fusing of the Duktil-chromium layer resulting in superior durability.

Bending test of hard chrome plating. The surface shows large fissures and significant areas are missing, due to a poor defusion with the base metal.

Flat test of Duktil-hard coating, polished to 600 : 1, fissure free. The hardness of Duktil is recorded at 1,620 Vickers and the base material is recorded at 180 Vickers.

Bending test of Duktil-hard coating, the adhesion to the base material is very good, no surface fissures.

Precision Design

seepex stators are molded-to-size, not molded in long tubes and simply cut to the length needed. It is an exact fit, custom designed.

Reliable Sealing

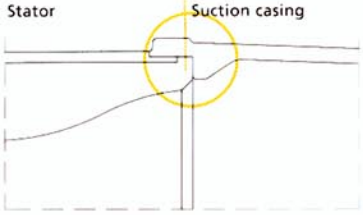
Because of its custom design, it is possible to mold the seal on both ends as an integral part of the elastomeric stator. This is especially important for corrosive or toxic products. Corrosion of the stator tube is never a problem because the pumped liquid never comes in contact with the metal tube.

This design also meets the demanding requirements of the food industry.

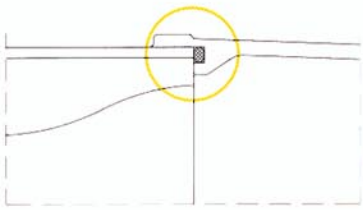
Integral seal collar

Stator

Suction casing



seepex standard



'O' ring seal
For **seepex**, an inferior technical alternative

Exact Geometries

Only a very good mating of the rotor and stator will guarantee high efficiencies and low power requirements.

An even compression between rotor and stator is critical to correct pump performance.

Most regular stators and those which are cut from long tubes have cylindrical cores, even throughout their length. During the vulcanization process, the stator elastomer shrinks more on the ends.

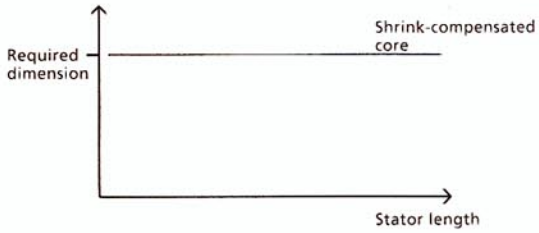
The **seepex** *core design compensates for this, ensuring rotor-stator fit along the entire stator length.*

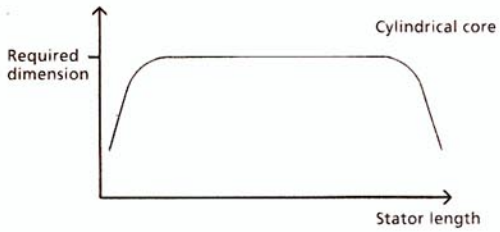
Various Elastomers

A wide variety of elastomers are necessary to specifically meet the application demands of progressive cavity pumps. **seepex** *has specific cores for different elastomers because of their individual shrink rates.*

Advantages of the Optimized Stator

- *High volumetric and mechanical efficiencies*
- *Low power requirements*
- *Lower starting and running torques*
- *Good pressure capabilities (particularly important at low rpms)*
- *Reliable sealing*
- *Service friendly, due to easy disassembly*

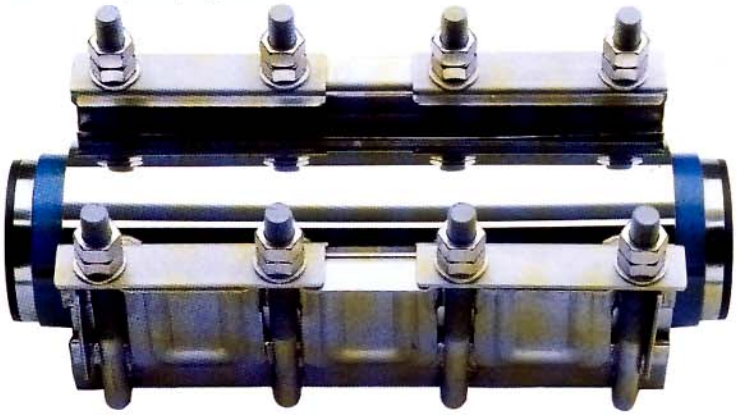




Additional Service Life Increases

seepex pumps with the **6L**-geometry already exhibit improved life over conventional designs by 30 to 50%, due to the reduced sliding velocity and the improved sealing lines in the pumping elements.

A further increase can be gained with the addition of the optional adjustable stator retensioning device.



The adjustable stator retensioning device consists of an adjustable sleeve manufactured in stainless steel, with an internal rubber lining and a series of adjusting bolts.

Depending on the size of the stator to be tensioned, adjusting bolts may be either on only one or on both sides of the device.

Increase in Component Life

The adjustable stator includes longitudinal slots to allow for the adjustment of the stator tube's circumference.

By using the adjustable stator retensioning device to reduce the circumference of the worn stator, the original compression between the stator elastomer and the rotor can be evenly restored.

Reduced Operating Costs

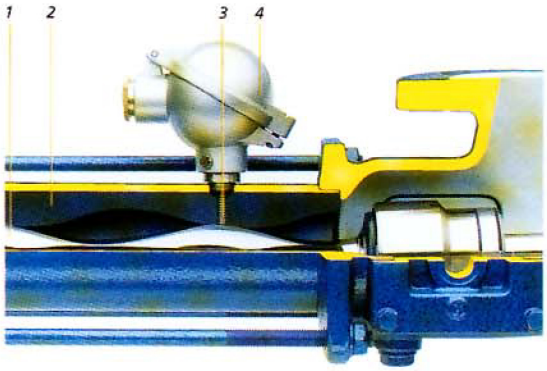
By retensioning the stator, the time between stator replacements can be increased by two or three times. The retensioning procedure is performed while the pump is in service; so, not only does it reduce replacement costs but it also cuts down-time. The stator retensioning device can be easily cost justified on many applications where abrasive materials are being handled.

A stator with radially opposed, longitudinal slots, ready for installation into the reusable stator retensioning device.

End view of an adjustable stator and retensioning device with adjusting bolts on both sides.

Patented

This **seepex** developed accessory, suitable for use on all **seepex** progressive cavity pumps, patent No. 2311770, provides the only universal solution that positively protects against dry running damage, the most common cause of failure in progressive cavity pumps.



Pump cross section with **TSE**

1 Rotor
2 Stator
3 Sensor sleeve with thermistor
4 Connection head

Function

The temperature between rotor and stator is continually monitored by a thermoelectronic sensor installed in the pump stator. This temperature is compared with the adjustable temperature setting on the **TSE** *control unit.*

If the pump runs dry, the temperature rises due to the increased friction between rotor and stator. Once the set point is reached, the **TSE** *control unit stops the pump drive and activates an alarm signal.*

Reliable

Destruction of the pump stator by dry running is caused by excessive friction and temperature on the surface of the stator elastomer, due to the loss of lubrication of the pumped fluid.

It is exactly this temperature, measured at its most critical point and the rise to a value which would have a destructive effect on the stator, that is avoided by a timely shutdown of the pump.

Universal Use

TSE *operation is independent of the pipe condition and the kind of pump installation. It safely functions not only with water but also with products which are abrasive, highly viscous, sticky or tend to coat or clog other types of devices.*

The **TSE** *measures the variable that causes stator damage, heat, and not indirect functions such as pressure or capacitance. It is the only universal solution for dry run damage.*

The **TSE** *control unit (with isolated relay contacts) is integrated within the starter of the pump motor and is connected to the temperature sensor, installed in the* **seepex** *pump. The maximum admissible temperature is adjusted at the potentiometer.*

A red LED malfunction signal is activated if the temperature gets too high. It remains until the manual 'Reset' function is engaged and then a green 'Run' LED is activated.

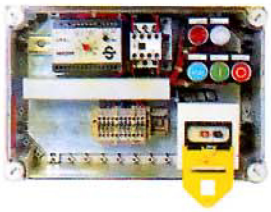
Operating voltage:

220-240 V / 50-60Hz (standard)
110/48/24 V / 50-60Hz (special)
24 VDC (special)

TSE controller as a chassis design for inclusion into the customer's motor or pump control center.

Special design:

Sensor circuit with installation of intrinsically safe 'Zener' barriers for use of the **TSE** *in hazardous areas.*



Complete pump operating panel with the **TSE** in IP55 (NEMA 4) enclosure, suitable for wall mount or inclusion onto cart mounted pump units.

In addition to the **TSE** *control unit, protective motor contactor, an 'On/Off/Reset' button and signal lamps for 'In operation' and 'Dry run' are installed, wired on terminal strips. For installation, only the power supply, electric motor and temperature sensor have to be connected.*

The **TSE** *is also available with a connection for a pressure switch, to protect the same* **seepex** *positive displacement pump from 'Deadhead' operation for overpressure. A shutdown due to overpressure is indicated by a separate signal lamp, until the manual 'Reset' is activated.*

ROTATING RIGHT

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