

## Hygienic rotary lobe pumps

# HP & LH SERIES

Gebruiksaanwijzing  
Mode d'emploi  
Instruction manual  
Betriebsanleitung



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# **1 INTRODUCTION**

## **1.1 GENERAL INFORMATION**

Thank you for purchasing PACKO products!

This manual for the HP & LH series Rotary Lobe Pumps describes safe and appropriate installation, use, disassembly and assembly, maintenance and troubleshooting of the pump.

Read and completely understand this manual to learn how to service these pumps prior to operating or servicing the product and observe to pay special attention to the warnings.

This manual must always be available at the installation location since no liability will be assumed for any damage or operational malfunctions arising from non-compliance with these operating instructions.

## **1.2 MANUFACTURER**

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B-8600 Diksmuide  
Belgium  
Telephone: + 32 51 51 92 80  
Telefax: + 32 51 51 92 99  
E-mail: [pumps.packo.be@verder.com](mailto:pumps.packo.be@verder.com)

## **1.3 COPYRIGHT**

These operating instructions are written to support the installation, the use and the maintenance of the pump in accordance with the European machinery directive. They are originally written in Dutch, English, French and German by the manufacturer. All other languages are translations of the original operating instructions.

PACKO INOX LTD has the copyright on this document. These operating instructions may be reproduced in full in the operating instructions of the machine or installation in which the pump is installed and may be used for training personnel who must work on or with the pump. Any other publication, reproduction in full or parts thereof is prohibited.

Although these operating instructions have been carefully drawn up, they do not however cover all possible eventualities that can occur during the installation, operation or the maintenance of the pump. In any event, the pump must not be used for purposes other than those stated when ordering and for which the pump has been constructed, as this could result in physical damage and injuries.

## 1.4 DECLARATION OF CONFORMITY

### Declaration of conformity according to annex IIA of the "Machinery" Directive 2006/42 EC

We,

Packo Inox Ltd  
Cardijnlaan 10  
B-8600 DIKSMUIDE  
BELGIUM

confirm that the Packo pump type ....., with serial number ..... fully  
complies with the Directive Machinery and with the (harmonised) standard EN 809, ENISO12100.

It must be brought to your attention that our product is intended to be built into a machine, and that,  
on the basis of the "Machinery" Directive, the complete (compound) machine can only be applied after  
matching the stipulations of the European demands.

PACKO Inox Ltd, Cardijnlaan 10, B-8600 DIKSMUIDE, BELGIUM is authorized to make up the technical  
construction file.

Date

.....

Signature:

.....

Wim Bonte  
BU Manager pumps  
Packo Inox Ltd

## 1.5 PRINCIPLE OF OPERATION

HP & LH pumps have 2 rotors which turn in opposite directions. Fluid enters the pump from the inlet port and fills the space between the rotors. This fluid is carried around the outside of the rotors and is forced out of the discharge port as the rotor lobes mesh together see Figure 1. Each rotor is supported on a shaft and when the pump is running within its operating limits, the rotors never touch the inside of the rotor case, or each other.

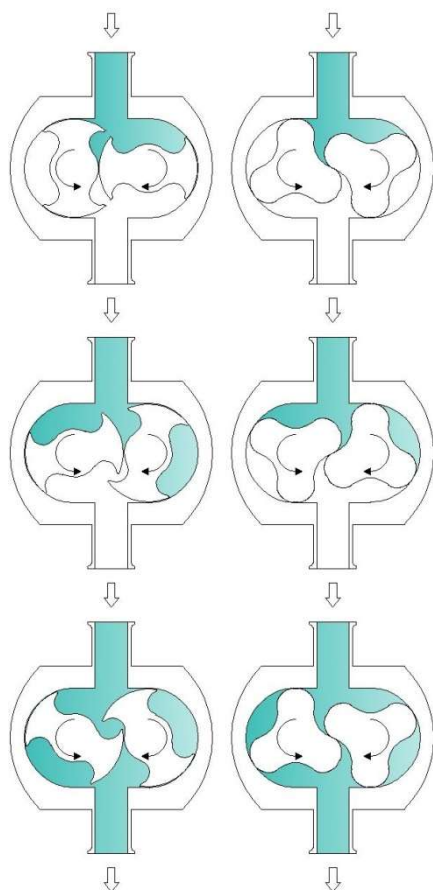


Figure 1 - Principle of operation (Showing vertical mounting)

## 1.6 INTENDED USE

The pump should only be used for pumping the media it was selected for and within the limits specified in the technical datasheets. Any other application beyond the intended use or conversion of the pump without written agreement with the manufacturer shall be deemed to be not in accordance with the intended use.

The pump may only be started up for the first time if it has been ensured that all safety devices

are completely fitted and functional.

If any areas are subject to have the risk of explosion, the relevant explosion-proof designed pumps should be used.

Intended use also covers compliance with the conditions of operation, servicing and maintenance specified by the manufacturer.

The pump is only to be put into operation filled with medium to be pumped.

Before starting up pay attention to:

- Open the valves on the suction side completely to avoid cavitation and,
- Open the valves on the discharge side completely to avoid exceeding the permitted differential pressure of the pump
- Discharge-side safety measures should be done (e.g. safety valve) to protect the pump from non-permitted excess pressure
- Protection against contact for hot, cold and moving parts must not be removed during operation

## 1.7 TYPE DESIGNATION

The type designation can be found on the pump name plate and also on both the order confirmation and customer invoice.

PACKO INOX LTD DIKSMUIDE BELGIUM		<b>Packo</b>	
TYPE:			
Mat. code:			
Year:	S/N:	kg	
Max:	bar	°C	
DO NOT RUN PUMP DRY OR AGAINST CLOSED VALVE			CE

Example (an X in the code denotes a special version):

Type: HP/44-213/114

- HP: pump series
- 44: pump type
- 213: Speed of the pump when the motor operates at 50Hz
- 11: motor power in kW multiplied by ten (11 = 1.1 kW)

- 4: number of poles of the motor

Mat. Code: (TLHP-95) D37SSVQ

- TLHP: Rotor code (TLHE = tri-lobe high efficiency, TLHP = tri-lobe high pressure, SCHE = scimitar high efficiency, SCHP = scimitar high pressure)
- 95: temperature class of the pump (Deg. C)
- D: type of couplings (D = DIN 11851, B = BSP, E = DIN 2642, F = DIN 2576, R = RJT, S = SMS, I = IDF, T = Tri-Clamp ISO2852, M = Tri-clamp ASME BPE, O = Tri-clamp ISO, N = ANSI flanges, V = DIN 11864-1, A = DIN 11864-2)
- 37: housing size of the NORD reductor
- S: seal configuration (S = standard single seal, Q = quench, D= double mechanical seal)
- S: mechanical shaft seal materials (S = silicon carbide / silicon carbide, I = carbon / stainless steel, K = carbon / silicon carbide)
- V: elastomer materials (E = EPDM, V = viton, M = teflon, P = NBR)
- Q: options (T = pump and motor reductor on trolley, U = pump and motor reductor on trolley with cover, P = bare shaft pump, Q = pump and motor reductor aligned on base plate, R = pump and motor reductor aligned on base plate with cover, J = on pedestal without foot)

Moreover, the year and week of construction, the pump serial number (to be stated when ordering spare parts), the weight, maximum operating temperature and maximum differential pressure are also marked on the name plate.

## 1.8 SOUND PRESSURE LEVEL

The sound-pressure level of the pump, operating at 50Hz without cavitation measured at 1m is less than 70dB(A). In order to minimize noise and vibration, no other parts of the machine may vibrate at the same time as the pump. The best solution is therefore to allow the pump to rest directly on the concrete floor, or to fit shock absorbers between the pump and the frame of the machine.

## **2 SAFETY**

Throughout this manual your attention is drawn to certain procedures which must be followed to ensure safe operation and servicing of this product.



### **ATTENTION**

Do not ignore safety instructions.



### **ATTENTION**

Do not remove by-pass or tamper with safety devices.



### **ATTENTION**

Do not use this equipment if the end cover (122) is removed, guards are missing or inlet & outlet pipework is not connected.



### **ATTENTION**

Do not forget the hazards of moving parts, high fluid pressure, extremes of temperature, hazardous, liquids, electricity.

Always isolate and lock-out the pump drive motor before inspecting or servicing pump.



### **ATTENTION**

Heavy lifting and work only to be done by suitably trained personnel.

## 3 INSTALLATION

Careful attention to correct installation of HP & LH pumps, and recognition of certain limitations to the operating conditions of the pump, will ensure long life and trouble-free running.



### ATTENTION

Failure to follow these instructions could result in personal injury or loss of life.

Take particular care over the following:

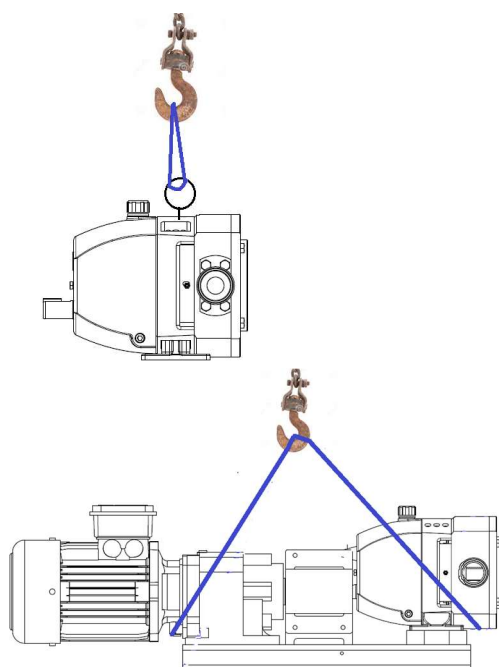
### 3.1 UNPACKING AND LIFTING OF THE PUMP

Unpack the pump/unit upon delivery and inspect it for visible transport damage.

Any damage occurred during the transporting has to be immediately reported to the transport agent after receipt of the consignment. Do not put the damaged products into operation.

The pumps need to be transported and secured with care to ensure no damage is caused. Smaller pumps without motor weigh less than 20kg and can be lifted by hand. Larger pumps with lifting eye bolt and complete units should be lifted as shown on the below pictures. Straps with sufficient load capacity must be used.

Make sure you set the pump down on a stable horizontal surface.



## 3.2 OPERATING LIMITATIONS

**PRIMING:** HP & LH pumps are not truly self-priming and should be installed in a "flooded inlet" pipe arrangement i.e. with the pump lower than the level of liquid to be pumped and with the supply pipe falling continuously to the pump with no loops.

**PRESSURE:** Do not operate the pump above the maximum differential pressure shown on the nameplate, not even for a few seconds, as damage to the pump components will result, leading to metal particles in the pumped fluid, ineffective cleaning and possibly complete pump seizure.



### ATTENTION

Never run the pump against a closed valve. Note that the pressure limit varies with the temperature.

**SOLIDS:** HP & LH pumps can handle soft solids in suspension but will be damaged by hard particles. Take care when pumping solids, crystals, etc.

Never allow metal parts to enter the pump, i.e. weld metal, screws, tools, etc. as these will stop the pump, leading to damaged rotors, rotor case and shafts.

**CAVITATION:** The pumps cannot operate without sufficient pressure of liquid at the inlet port of the pump. Normally atmospheric pressure is sufficient but the actual pressure needed, is higher for:

- High Viscosities
- High Temperature
- High Pump Speeds
- Volatile Liquids

Insufficient inlet pressure will cause the pump to cavitate leading to low performance, noise and short pump life. Ensure inlet pipes are short, large bore and do not collapse under vacuum.

## 3.3 LOCATION & ORIENTATION

The pump should be located:

- As close as possible to the fluid source and as low as possible to maximize the net inlet pressure available to the pump.



- In a clear area allowing access all around pump and drive for easy servicing.
- With space above for lifting equipment required.
- With port axis vertical if pump is required to be self-draining.

All HP & LH pumps are equally suitable for both directions of rotation.

HP & LH pumps can be rotated to give horizontal port orientation with top or bottom input shaft positions or vertical port orientation with left or right input shaft positions.

See Figure 2, Figure 3, Figure 4, Figure 5, & Figure 6.

This is achieved with the bolt-on feet and re-positional gear cover. (Ensure gearbox is drained of oil prior to gear cover removal)

To change any pump from vertical to horizontal pipework or vice versa, the correct foot kit needs to be applied. Foot kits contain all components required to change orientation.

See below for orientation setup after the packing feet have been removed.

To orientate the pump for:

#### Horizontal Ports Top Shaft Drive

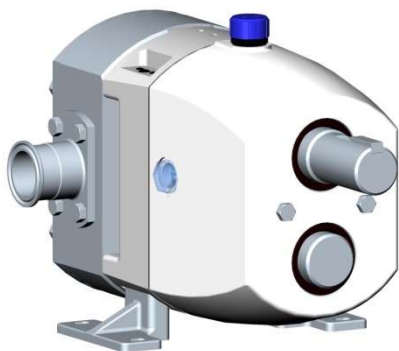


Figure 2 - Horizontal ports top shaft drive

- Remove black hole covers from foot location recess and place in a safe location (33 & 34)
- Push foot dowel pin (32) (Supplied in foot kit) into the un-tapped hole in the bottom foot location recess.
- Mate dowel pin in bottom foot location recess into dowel pin hole in horizontal foot (22).
- Push foot home until foot face mates with foot location recess face.

- Fit foot bolts (21) (Supplied in foot kit) through the feet into the bearing housing (1) and tighten to torque specified in Table 1.
- Repeat process for 2<sup>nd</sup> foot.
- Refit black hole covers into top foot location recesses.

#### Horizontal Ports Bottom Shaft Drive



Figure 3 - Horizontal ports bottom shaft drive

- Remove the black hole covers from the foot location recess and place in a safe location (33 & 34)
- Push the foot dowel pin (32) (Supplied in the foot kit) into the un-tapped hole in the top foot location recess.
- Mate the dowel pin in the top foot location recess into the dowel pin hole in the horizontal foot (22).
- Push the foot home until the foot face mates with the foot location recess face.
- Fit the foot bolts (21) (Supplied in the foot kit) through the feet into the bearing housing (1) and tighten to the torque specified in Table 1.
- Repeat the process for the 2<sup>nd</sup> foot.
- Refit the black hole covers into the top foot location recesses.
- Remove the key (29) from the drive shaft end.
- Remove the 2 bolts (18) from the gear cover (11) and slide the cover off of the shaft end, being careful not to damage the inside of the lip seal on the edges of the keyway in the shaft. Rotate the gear cover 180° and re-fit by tightening the 2 bolts. Tighten to the torque specified in Table 1.

Vertical Ports Left Shaft Drive  
(When viewed from front)

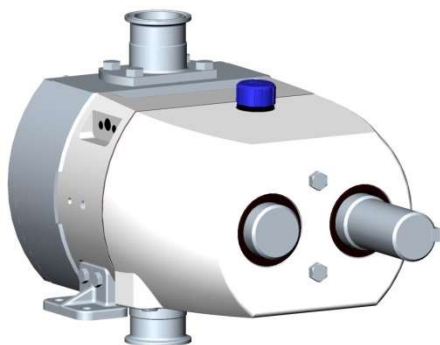


Figure 4 - Vertical ports left shaft drive

- Remove the black hole covers from the foot location recess and place in a safe location (33 & 34)
- Push the foot dowel pin (32) (Supplied in the foot kit) into the un-tapped hole in the bottom right foot location recess.
- Mate the dowel pin in the bottom right foot location recess into the dowel pin hole in the vertical foot (22).
- Push the foot home until the foot face mates with the foot location recess face.
- Fit the foot bolts (21) (Supplied in the foot kit) through the feet into the bearing housing (1) and tighten to the torque specified in Table 1.
- Repeat the process for the 2<sup>nd</sup> foot using the top right foot location recess.
- Refit the black hole covers into the left foot location recesses.
- Remove the breather plug (12) and sight glass (13) and swap their positions. Tighten the breather plug and sight glass to the torque specified in Table 1.

Vertical Ports Right Shaft Drive  
(When viewed from front)



Figure 5 - Vertical ports right shaft drive

- Remove the black hole covers from the

foot location recess and place in a safe location (33 & 34)

- Push the foot dowel pin (32) (supplied in the foot kit) into the un-tapped hole in the bottom left foot location recess.
- Mate the dowel pin in the bottom left foot location recess into the dowel pin hole in the vertical foot (22).
- Push the foot home until the foot face mates with the foot location recess face.
- Fit the foot bolts (21) (Supplied in the foot kit) through the feet into the bearing housing (1) and tighten to the torque specified in Table 1.
- Repeat the process for the 2<sup>nd</sup> foot using the top left foot location recess.
- Refit the black hole covers into the left foot location recesses.
- Remove the key (29) from the drive shaft end.
- Remove the 2 bolts (18) from the gear cover (11) and slide the cover off of the shaft end, being careful not to damage the inside of the lip seal on the edges of the keyway in the shaft. Rotate the gear cover 180° and re-fit, tightening the 2 bolts. Tighten to the torque specified in the torque table below.
- Remove the breather plug (12) and the sight glass (13) and swap their positions. Tighten the breather plug and the sight glass to the torque specified in Table 1.

For HP32 and HP34 only

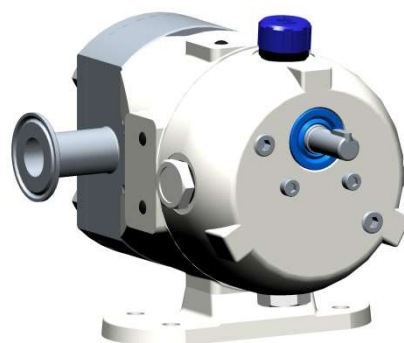


Figure 6 - HP32 & HP34 only

Due to the HP32 and HP34 design only 1 foot is required for all variations of port and shaft combinations.

- Remove the black hole covers from the foot location recess and place in a safe location (34)
- Align foot mating face on desired bearing housing boss face to achieve required shaft and port orientation.

- Fit the foot bolts (21) (Supplied in the foot kit) through the feet into the bearing housing (1) and tighten to the torque specified in Table 1.

Pump Size	Fixing	Torque Nm
HP3	Foot Bolt	25
	Gear Cover Bolt	8
HP4	Foot Bolt	25
	Gear Cover Bolt	8
HP5	Foot Bolt	72
	Gear Cover Bolt	10
HP6	Foot Bolt	72
	Gear Cover Bolt	10
Feet bolts should have thread lock applied before fitting such as 'Loctite 243 Thread Lock'		

Table 1 - Torque Table

### 3.4 DRIVES

If the HP & LH pump was supplied in bare shaft form i.e. without a drive motor, the drive must be selected and supplied to suit each individual application.

Pay attention to special motor requirements.

- Explosion/flame proof
- Hose proof/splash proof
- High ambient temperature
- Frequent stop/starts
- Materials of construction
- Available electrical voltage and frequency

Provision of a variable motor speed (i.e. by frequency inverter), is always recommended to enable flow to be accurately set, accommodate changes in fluid viscosity, changes in temperature, or to run the pump faster for cleaning. Variable speed motors must be selected to accommodate the full power and torque requirements throughout the operating speed range.

Transmission to the pump shaft will normally be by one of the following:

#### Direct Coupling:

If synchronous motor speeds can be matched to the required pump speed, the drive can be via a proprietary flexible shaft coupling.

A torque limiting coupling can protect the pump against overload.

In all cases the coupling manufacturer's limits should be adhered to.

See performance curve to calculate torque.

Pump and motor shafts should be accurately aligned in accordance with the coupling manufacturer's instructions.

#### Motor reductor:

For pump speeds lower than synchronous motor speeds, a proprietary motor reductor may be fitted. Variable ratio units are available to allow the pump speed to be adjusted. Coupling to the pump will be as in above bullet point.

### 3.5 BASEPLATE

The pump and drive will normally be mounted on a common baseplate or frame which must be strong and rigid enough to withstand the drive reaction forces as well as to support the equipment without vibration. Ensure the base is level as distortion could affect coupling alignment. Always check pump to drive alignment after installation and before starting the pump.

For hygienic applications the following conditions should also be met:

- Baseplates should be constructed from stainless steel or coated / painted mild steel.
- Legs, when used, must have either rounded ends or have flat load bearing feet suitable for floor mounting with no exposed threads.
- Legs made from hollow stock must be sealed.
- Baseplates should be sealed to the floor.

### 3.6 GUARDS AND SAFETY



#### ATTENTION

A pump never functions independently. It is intended to be incorporated into machinery. It should only be put into service if the machinery has been declared to conform to the provisions of the EC-directive "Machinery" (2006/42/EC).



#### ATTENTION

All moving parts must be guarded, and in

accordance with the applicable Directive.

Local safety regulations and codes of practice will specify the minimum acceptable standard but as a guide:

- Couplings, belts and pulleys must be enclosed to prevent fingers, clothing or tools from touching moving parts.
- Guards must be made from corrosion resistant materials.
- Guards in hazardous areas must be made from non-sparking material.
- Guards must be securely fixed.
- Pump must not be operated with guards removed.

### 3.7 ELECTRICAL CONNECTION OF THE MOTOR

The electrical connections may only be made when no electrical power is connected and by qualified personnel in accordance with EN 60204 and the local regulations. Special attention must be paid to optimal earthing of the motor; this must be performed in accordance with the applicable regulations in the relevant country. Check on the name plate of the motor whether the motor can operate from the available voltage and frequency.

The connecting cables and the protection system against excessive currents must be chosen according to the data on the name plate of the motor. The voltage drop during the starting of the motor may not exceed 3 %.

Tighten the nuts of the connector terminals in accordance with the torque values (Nm) stated below:

Terminal	M4	M5	M6	M8	M10	M12	M16
Steel	2	3.2	5	10	20	35	65
Copper	1	2	3	6	12	20	50

Do not install any washers or nuts between the cable lugs of the motor windings and the cable lugs of the connecting cables.

Inspect the seal of the gland. The gland must match the diameter of the connecting cable used. Bending of the cable beside the gland must not allow water to penetrate. (Allow the cable to be routed downwards when it leaves the motor.)

Connect the motor in star or delta according to the designation on the name plate of the motor and in accordance with the diagram that is installed in the terminal box. Do not connect the motor if you have any doubts regarding the interpretation of the connection diagram. If in doubt please contact PACKO. Never check the direction of rotation of the pump when the terminal box is open. The technician is responsible for complying with the regulations relating to electrical compatibility in the country where the pump is installed.

The voltage and the frequency stated on the name plate of the motor must be observed. (Tolerance of 5 % for the voltage, and 1 % for the frequency.)

For pumps whose power exceeds 7.5 kW, special starting provisions must be provided (star-delta starter, soft starter, or starting with frequency converter).

**The installation of an overcurrent protection device is always mandatory.**

### 3.8 PORTS AND PIPEWORK

To add or change any pump ports the correct port kit needs to be applied. Port kits contain all components required to change assemble the ports to the pump.

The correct port gasket (elastomer type) is supplied with the pump.

- Ensure the port seal (53) is free from debris
- Push the port seal into the seal area on the port flange (54). (Seals will only fit in one orientation)
- Locate the port (with seal assembled)(53 & 54) on the rotor case (51) using the location boss on the port and recess on the side of the rotor case. (This is a small circle on HP pumps locating around the seal area locating on the outside diameter of the port flange.)
- Fit the port bolts (55) through the port into the rotor case and tighten to a torque of 20Nm.

**Note:** HP3 size and LH pumps have welded ports.

Pipe runs and sizes should be established at the time the pump is selected.

When installing the pump do not deviate from this design without rechecking the pump selection:

- Keep pipe runs short and pipe diameters large; pipes may need to be larger diameter than pump ports especially when pumping viscous liquids to prevent cavitation.
- Use large radius bends and full bore valves. Avoids globe or needle valves on viscous fluids.
- Fit isolation valves on each side of the pump to simplify maintenance.
- Fit vacuum/pressure gauges each side of pump to monitor pressure conditions. Once the process is established (and will not change), these can be removed.
- Avoid filters on the inlet side of the pump if possible. A clogged filter will cause cavitation. A strainer - maximum hole size 50 microns - will help to protect the pump from damage by particles, but must be kept clear.
- Support the pipework - the weight of the

pipe and the fluid within may not rest on the pump.

- Fit expansion joints if necessary to prevent thermal expansion forces being transmitted to the pump.
- Ensure all pipe joints are:
  - Air-tight under vacuum;
  - Liquid tight under pressure, and;
  - Steam tight where applicable.
- Take special precautions when pumping hazardous, hot, toxic or bacteriological fluids - special joints and high specification seals may be required.
- Use hot water/steam jackets or electrical resistance tape to heat pipes carrying liquids which thicken when cool. Provide an interlock to prevent the pump from running unless the liquid in the pipes is at correct temperature to avoid over pressure, cavitation, or excessive drive shaft loads.

### 3.9 ENLARGED RECTANGULAR INLET

The weight of the hopper (Including the product it contains) must be supported separately and is not allowed to rest entirely on the pump as this would affect the rotor clearances leading to pump seizure. The mating flange of a hopper or screw feeder should be machined to the identical dimensions of the rectangular inlet and sealed. This will avoid ledges where product could 'hang up'. Ensure effective flow of viscous material into the pump.

### 3.10 TEMPERATURE CONTROL JACKETS

Pumps are available with optional temperature control jackets. These allow hot or chilled water, oil or steam to be piped to the pump to maintain the product temperature in the pump or to heat the pump prior to starting.



## Pump Head – Thermal Jacket

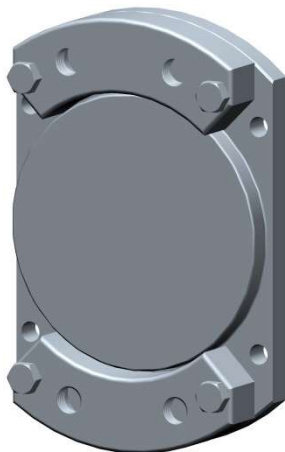


Figure 7 - Pump head - thermal jacket

Can be used in conjunction with end cover relief valve.

## End Cover – Thermal Jacket



Figure 8 - End cover - thermal jacket

Application limits are:

- Jacket Pressure: 2 bar (30 psi).
- Temperature: 130°C (265°F).

## 3.11 SEALS AND FLUSHING

Three basic types of mechanical face shaft seal are available on the HP & LH pumps.

The correct type should have been selected when the pump was originally selected but you must establish that the seal fitted is suitable for the application before starting the pump.

Provide flushing system as required.

There is also 1 seal which is not a mechanical face type; this is the Packed Gland seal available on HP42/44 and HP52/54 size pumps.

The **Single Mechanical Seal** is suitable for

many clean fluids which do not require a more sophisticated seal type. (Figure 9)

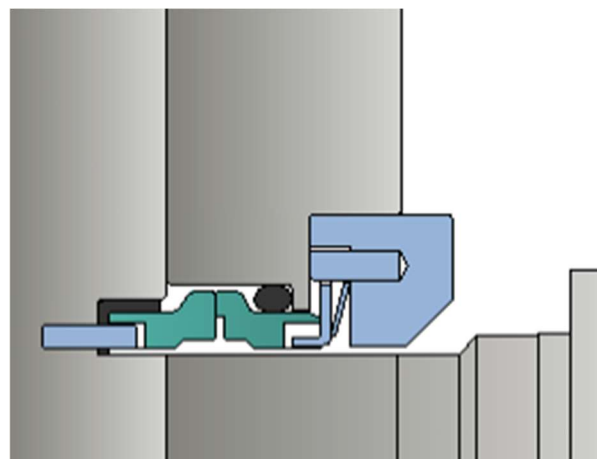


Figure 9 - Single mechanical seal (Size 4-8)

Note that silicon carbide-on-silicon carbide, seals are not recommended for steam-purged applications as the seal faces can bind together – see chapter 5 CLEANING AND STERILISATION.

Pumps fitted with single seals require no special installation.

However, pumps must never run dry, as this will cause excessive heating of the seal faces.

Use flushed seals in pumps that need to run dry.

The **Flushed Mechanical Seals** fitted to HP & LH pumps are run with a low-pressure liquid flush between the primary mechanical seal and a lip seal to form a barrier between the pump and the atmosphere.

This allows the pump to be used for applications where the single seal is unsuitable. (Figure 10)

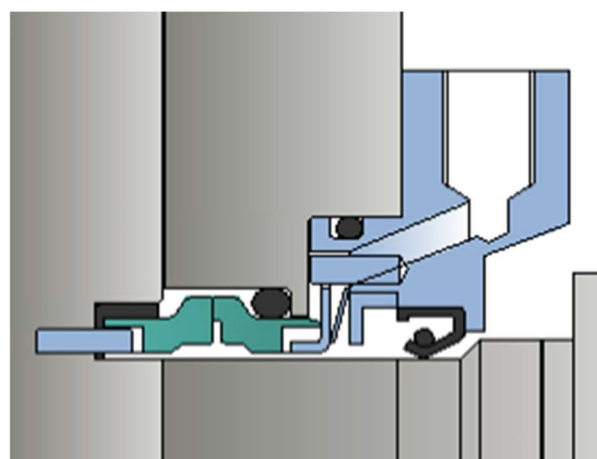


Figure 10 - Flushed single seal (Size 4-8)

**Flushed seals are used when:**

- Pumped fluid changes state in contact with air, i.e. crystallizes, forms a film, dries out or precipitates solids. The flush dissolves and rinses away the small amount of residue which could build up on the edges of the seal faces.
- Pumped fluid is close to its boiling point, e.g. water over 80°C (175°F). The flushing fluid is used to cool the seal faces.
- Pumped fluid is temperature sensitive and evaporates when heated by the shearing action of the seal faces. The flushing fluid is used to cool the seal faces.
- Pump may run "dry", i.e. no liquid in pump chamber for very short periods.
- Pump is under high vacuum.
- A low pressure sterile barrier is required.

**A low-pressure flushing fluid system must be installed as follows:**

- Liquid must be compatible with the pumped fluid; water is the most commonly used liquid.
- Pressure shall typically be 0.5 bar (7 psi) gauge. Maximum of 1.0bar (14.5 psi) gauge.
- Temperature shall be maximum of 70°C (160°F) for water, less for volatile liquids (minimum 20°C (68°F) below boiling point of liquid).
- Flow rate shall preferably be 2 to 3 litres/hour per seal.
- Flush fluid should be connected to enter at the lowest point on the seal housing and flow out at the highest point to vent air pockets.
- Pipework should be as shown in the diagram (Figure 11).

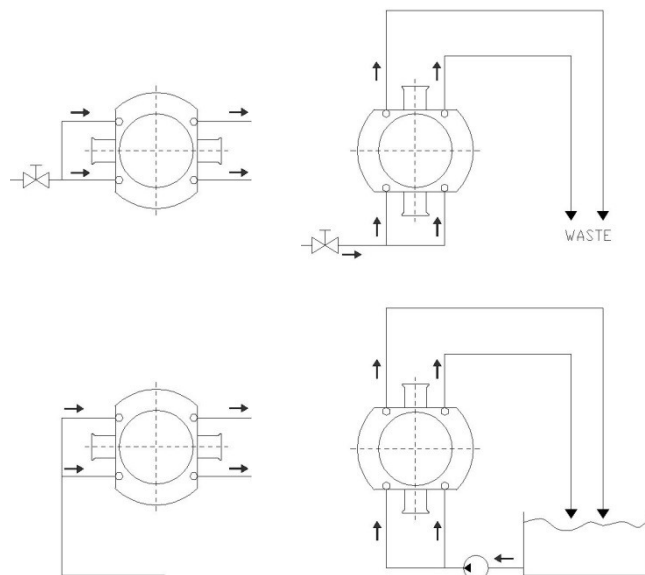


Figure 11 - Suggested low pressure flushing system

The **Double Mechanical Seals** fitted to HP & LH pumps provide the facility to contain a high pressure fluid behind the primary seal. This allows the pump to be used for applications where the single seal is unsuitable.

Double seals code D are run with a fluid between the primary and secondary mechanical seals to form a barrier between the pump and the atmosphere. (Figure 12)

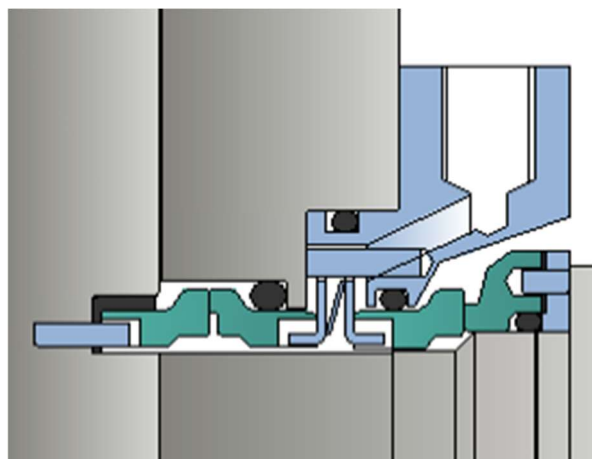


Figure 12 - Double mechanical seal (Size 4-8)

**Double Mechanical Seal with a low pressure liquid flush when:**



**ATTENTION**

- The pumped fluid is toxic or hazardous and must not escape from the pump even in minute quantities.
- The system can be installed as in figure 12, but must be capable of withstanding

the full pressure within the pumped fluid pipe system.

### Double Mechanical Seal with a high pressure liquid flush when:

- The pumped fluid has no lubricating properties and cannot be allowed onto seal faces
- The pumped fluid is highly viscous, i.e. over 150,000 cP.
- A high pressure sterile liquid barrier is required.

When the double seal is used with a high pressure liquid flush for the reasons described above, a flushing system must be installed as follows:

- The flushing liquid used must itself be compatible with the pumped fluid and must itself not require a complex seal, i.e. must be non-hazardous, non-abrasive and lubricating.
- Flush liquid must be at a pressure of 1 bar (15psi) above the discharge pressure of the pump and should flow at 35 to 55 litres/hour (10 to 15 US gal/hour) per seal.
- Flush fluid should be connected to flow in at the lowest point on the seal housing and out at the highest point to vent air pockets.

Refer to the drawing below for the suggested liquid flush system (Figure 13).

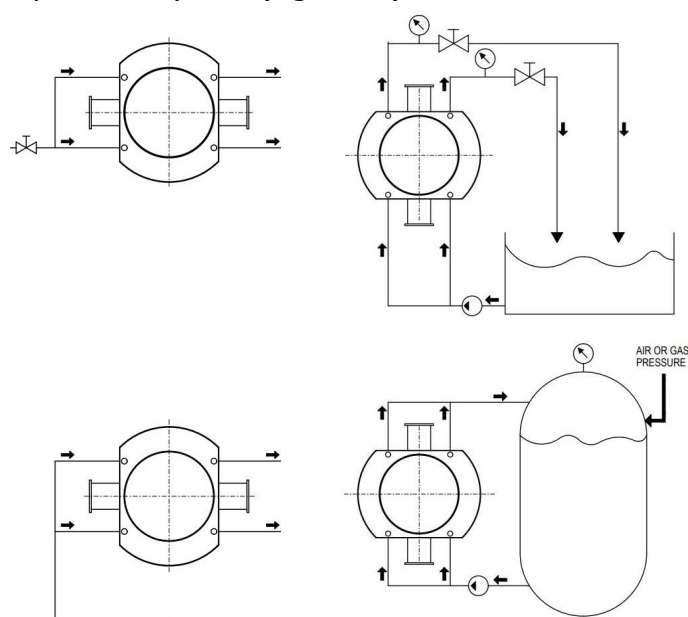


Figure 13 - High pressure liquid supply for double seals

### Double Mechanical Seal with steam when:

No bacteria or contamination can be allowed to enter the pump, i.e. an aseptic system.

A steam barrier system must be installed as follows:



#### ATTENTION

- Wherever possible, sterile liquid i.e. steam condensate should be used as a flush. Condensate should be connected to flow in at the lowest point on the seal housing and out at the highest point to vent air pockets.
- Where steam is essential, great care must be taken with the design of pipework, steam traps and controls.
- Steam must be clean, filtered and wet, i.e. not superheated.
- The pressure of steam should be as low as possible consistent with the desired temperature.
- Steam should be connected in at the highest point on the seal housing and out at the lowest point to allow any condensate to drain from the lowest point.
- Refer to Figure 14 for suggested steam connection.



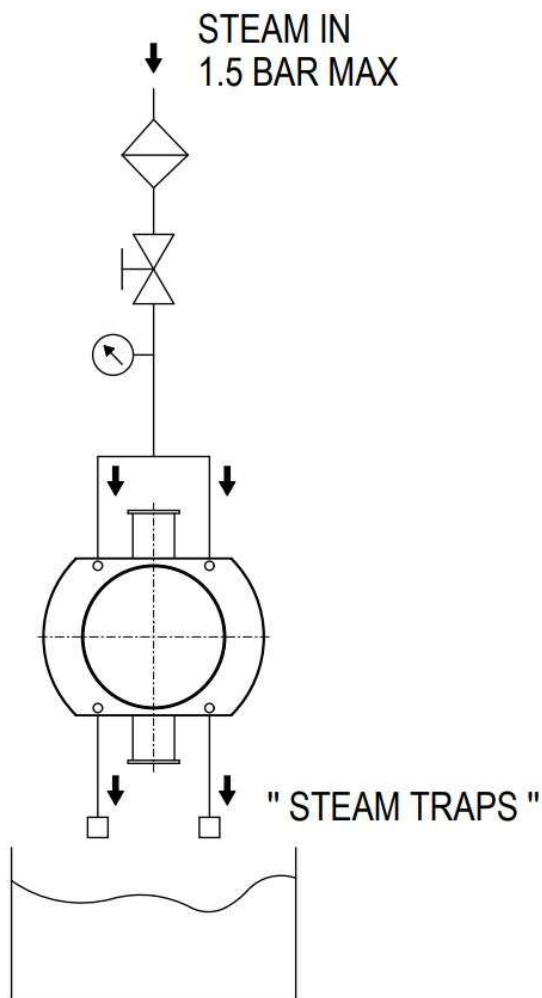


Figure 14 - Steam barrier flush system for double mechanical seal



#### ATTENTION

Silicon carbide on silicon carbide seals are not recommended for steam flushed applications.

Double mechanical shaft seals are not available on the **HP32** or **HP34** size pumps.

### 3.12 SEAL MATERIALS

#### SEAL FACES

All primary seals are available with carbon on-silicon carbide faces for non-abrasive fluids and silicon carbide on-silicon carbide faces for abrasive fluids containing crystals, powders or particles or when no particles of wear can be allowed to enter the pumped fluid. Silicon carbide-on-silicon carbide seals are not recommended for steam flushed applications.

Carbon on stainless steel single seals are

available for nonabrasive and lubricating fluids.

All secondary double mechanical seals are with carbon on silicon carbide faces.

#### ELASTOMERS

Product contacting primary elastomers must be selected to be compatible with the product and the process operation.

Consideration must be given to chemical compatibility, temperatures and material standards. HP & LH pumps are available with a range of elastomers:

Nitrile
1935/2004 EC, FDA grade
EPDM
1935/2004 EC, FDA grade
Viton
1935/2004 EC, FDA grade
PTFE
1935/2004 EC, FDA and USP grade

Table 2- Elastomer approvals

Consult the supplier for more information.

### 3.13 END COVER RELIEF VALVE

HP & LH pumps can be fitted with a cover relief valve which can be set to protect the **PUMP ONLY** from overpressure.



#### ATTENTION

This valve is not designed to protect the system or to provide long term by-pass of liquid.

If this is required then an IN-LINE relief valve should be fitted which can by-pass the liquid back to the suction vessel during overpressure situations.

The maximum pressure rating of the pump is stated on the **nameplate**.

The relief valve should be set so that it opens before it reaches this pressure.

Be aware that there may be a piece of equipment in the system that is limited to a lower pressure than the pump. (See section 3.11 SEALS AND FLUSHING)

If this is the case then the pump end cover relief valve should be set so that the pump cannot

exceed this pressure.

### Setting the relief valve:

This should be done, if possible, using the liquid to be pumped.



Figure 15 - Relief valve

- Screw the adjusting screw (135) clockwise so it enters the housing as far as possible. This ensures that the valve is fully closed.
- A pressure gauge is required to be fitted in the pipe system directly after the pump.
- Start the pump running.
- Increase the pressure on the pump by closing a valve downstream or increasing the pump speed. Continue until the desired relief valve pressure setting is achieved.



#### ATTENTION

- MAKE SURE THAT THE MAXIMUM PRESSURE OF THE PUMP IS NOT EXCEEDED. CHECK THE **NAMEPLATE**.
- Start unscrewing the adjusting screw (135) counter-clockwise until the pressure gauge reading starts to drop.
- If a small rod is inserted into the end of the adjusting screw until it contacts the end of the valve guide (134) it is possible to feel the movement of the valve.

### The valve is now set.

- Check the relief valve setting by opening the downstream valve or reducing the pump speed. It will be necessary to reduce the pressure to approximately 10% of the set pressure to ensure full closure of the relief valve.
- Alternatively stop the pump.
- Re-start the pump or increase the

pressure as stated in relation to the setting of the relief valve.

- The relief valve should open at the set pressure.
- Make further adjustments if necessary.

### Overload protection



#### ATTENTION

To prevent injury to personnel or damage to the pump or system caused by excessive pressures, a protection device should be fitted such as:

- A pressure switch or sensor that stops the drive motor. Ideally, the motor should be fitted with a brake.
- A pressure relief valve or bursting disc fitted downstream of the pump and necessary piping to direct excess fluid away safely.
- A relief Valve fitted to the pump end cover.
- A torque limiting coupling between drive and pump shaft.
- A motor current sensor.



#### ATTENTION

Protection devices must be set to operate at, or below, the safe operating pressure of the pump or of the system, whichever is the lower.

**NOTE;** that maximum pressure varies with the temperature.

## 3.14 LUBRICATION

Packo HP & LH pumps have oil lubricated shaft bearings and timing gears.



#### ATTENTION

Pumps are supplied with Nevastane XSH150 oil in the bearing housing.

- After the first 120 hours of service, drain the lubricating oil from the bearing housing and refill with fresh oil of the correct grade.
- Check oil level regularly and top up as necessary.
- Any substantial oil losses should be investigated immediately.

Oil capacity gearbox:

Pump model	Oil capacity
HP/32 & 34	0,38 liter
HP/42 & 44	0,66 liter
HP/52 & 54	1,17 liter
HP/62 & 64	2,20 liter
LH/72, 74 & 76	5,50 liter

## 4 START UP & ROUTINE CHECKS

### 4.1 START UP

Before starting the pump for the first time or after servicing or maintenance work, check the following - failure to do so could damage equipment or cause injury to personnel.

- Pump and pipes are clear of welding flash or other debris.
- All pump head and mounting bolts are tight.
- All pipe connections are secure
- All guards, safety and protection devices, are in place and effective.
- Check the motor is wired for the correct direction of rotation (Figure 16 and Table 3 - Direction of flow)
- Flushing fluid, if required, is flowing. (See 3.11 SEALS AND FLUSHING )



#### ATTENTION

Do not use HP or LH pumps to flush the system the first time. Flush the whole system with suitable cleaning agents before starting the pump, using another more suitable pump if necessary.

Be aware that heavy or metal debris tends to collect at the lowest point in the system.

- All valves are open - **NEVER** run the pump against a closed valve.
- Pipes and pump head, if heated, are to normal operating temperature.
- Pump is correctly lubricated. (See 3.14 LUBRICATION)

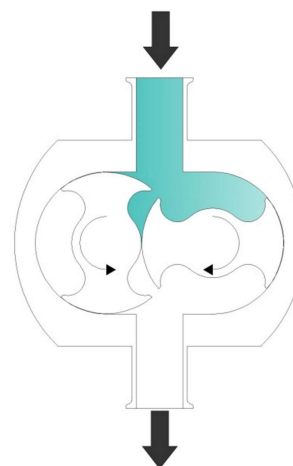


Figure 16 - Direction of rotation - viewed from pump head (Principle applies to all mounting orientations)

DIRECTION OF FLOW		
	VIEWED FROM PUMP HEAD END	
DIRECTION OF DRIVE SHAFT	CLOCKWISE	ANTI-CLOCKWISE
HORIZONTAL PORTS TOP SHAFT DRIVE	LEFT TO RIGHT	RIGHT TO LEFT
HORIZONTAL PORTS BOTTOM SHAFT DRIVE	RIGHT TO LEFT	LEFT TO RIGHT
VERTICAL PORTS LEFT SHAFT DRIVE	BOTTOM TO TOP (UP)	TOP TO BOTTOM (DOWN)
VERTICAL PORTS RIGHT SHAFT DRIVE	TOP TO BOTTOM (DOWN)	BOTTOM TO TOP (UP)

Table 3 - Direction of flow

When possible, start the pump slowly and increase speed gradually.

- Listen for unexpected noises.
- Check for leaks.
- Check that the pump gives the desired flow rate, using the pumped media at normal operating speed.
- Do not continue to run the pump if the fluid is not flowing; dry running can damage seals. (See 3.11 SEALS AND FLUSHING)



#### ATTENTION

- Observe the pump during the first few hours of operation - check for noises and excessive heating of pump, e.g. if above 80°C (176°F), unless pumping hot liquids

when 110°C (230°F) may be reached.

- If operating at high speeds or with hot liquids, the surface of the pump can become hot.

## 4.2 DAILY CHECKS

- Visual checks of all seals for signs of leakage of product, flushing liquid (if used) and oil from the gearbox.
- Check the Packed gland seal for excessive leakage (if used)
- Listen for any unusual noises
- Check for any vibration or temperature changes.
- If minor problems are identified these should be rectified at the end of the shift and if major they should be attended to at once.

## 4.3 WEEKLY CHECKS

- As Daily Checks.
- Remove the end cover of the pump and inspect for signs of damage or wear. Repair or replace if necessary.
- If the main product shaft seals are of the packed gland type, inspect them for signs of wear. Replace or plan for replacement as necessary.
- Check the lubrication level and top up if necessary. This must be done with the pump stopped.
- Check lubrication level on drive unit and top up as necessary. Follow the manufacturer's instructions.

## 4.4 MONTHLY CHECKS

- As Weekly Checks.
- Remove the end cover and inspect the surfaces.
- Visually check the rotor surfaces.
- If an end cover relief valve is fitted check its function. If the relief valve is not operating on a regular basis the diaphragm may have a tendency to stick.

## 4.5 SIX MONTHLY CHECKS

- As Monthly Checks.
- Change the end cover O-ring or end cover gasket.
- Remove the rotors for visual inspection

and signs of wear.

- Inspect the seal faces for wear and the condition of the elastomers. Replace if necessary or note for planned maintenance.

## 4.6 ANNUAL CHECKS

- Change the mechanical seals if fitted, and if required.
- Replace the lip seal on the mechanical seal flush housings.
- Replace the end cover relief valve diaphragm.
- Change the packing rings on the packed gland type shaft seals.
- Change all L-cups, O-rings and/or gaskets on pump head.
- Inspect gearbox oil seals and gear cover gasket for signs of leakage and replace if necessary.
- Check bearing wear by seeing if there is any movement of the shaft side to side or forwards and backwards. If movement is perceived remove the gear cover and dismantle the bearings for inspection, replace if necessary.
- Drain and change the oil in the pump gearbox.

By ensuring a visual inspection daily and regular checks at planned intervals, pumps can be maintained to maximum performance for many years.

**Failure to maintain the pump by carrying out the above checks may invalidate warranty.**

# 5 CLEANING AND STERILISATION

HP & LH pumps are designed for use with products that require the process equipment and pumps to be cleaned. The standard (level) of cleaning or sanitization required depends on the needs of the process and product. This information is provided for guidance only. It is the responsibility of the pump user to make sure that the cleaning protocol chosen is adequate to achieve the desired levels of cleanliness and Packo cannot accept any responsibility for

contamination or loss.

In order to clean the pump it must either be dismantled (manual cleaning), or cleaned in place (CIP) as part of the procedure for cleaning the entire process. The higher the standard required, the more sophisticated the cleaning process. Pumps can be cleaned and sterilized in place, i.e. by flushing through with cleaning agents and/or steam, without the need to dismantle the pump.

Equally the pump can be quickly stripped to gain access to all fluid contact surfaces for manual cleaning or inspection if required.

## 5.1 CLEANING IN PLACE (CIP) & MANUAL CLEANING

### Cleaning Systems

The type of cleaning system used depends partly on the level of cleaning required but also on what is to be removed.

Organic materials such as oils, fats, proteins need a different system to inorganic materials such as mineral salts.

Detergent manufacturers can give advice on the correct use of chemicals and temperature. CIP usually needs a velocity of 1.5 m/sec at 1 bar back pressure through the pipeline to achieve the turbulent flow required.

### Procedure for Cleaning In Place (CIP)

Each pump is supplied in a generally clean condition but it is the responsibility of the user to establish suitable cleaning and sterilizing regimes appropriate to the fluid and process.

These should be implemented before the pump is first used and as often as required thereafter. The following guidelines will help with effective cleaning of HP & LH pumps to minimize risk of damage to the pump.

- Rinse through system with a suitable liquid, usually water at approximately 50°C (120°F), as soon as possible after completion of the process to remove bulk of residues before they dry onto surfaces.
- If CIP will not be carried out immediately after rinsing, leave the pump and system full of rinse liquid.
- Choose chemical cleaning agents to suit the nature of the contamination to be removed and use them in accordance with

manufacturer's recommended dilution, temperature and circulation time but do not exceed 90°C (195°F). Confirm compatibility with pump materials of construction.

- CIP fluid flow should result in a mean pipeline velocity of at least 1.5 m/sec at 1 bar back pressure.

If using the lobe pump to circulate the CIP fluid, refer to the **Performance Data Sheet** for the pump speed to give the required flow, taking account of pressure losses through pipework. **NOTE**, that all pumps are more susceptible to cavitation when pumping hot liquids. Ensure adequate Net Inlet Pressure is available.

If using a separate pump to circulate CIP fluids, the lobe pump may need to be rotated at a speed sufficiently high to allow the fluid to pass freely through. If sufficient pipe velocity cannot be achieved, fit a by-pass loop to divert excess flow past the pump.

CIP fluid pressures must equal or exceed process pressure at all points in the system to ensure fluid reaches all contact surfaces.

It may be necessary to restrict flow in the discharge pipework to achieve this but do not exceed differential pressure and temperatures shown on the pump **Performance Data Sheet**.

A minimum differential pressure of 1 bar is recommended for effective cleaning.

- After CIP, rinse through with neutralizers and clean water to remove all traces of cleaning agents.



### ATTENTION

Do not pass cold liquid through the pump immediately after hot – allow temperature to change slowly. Failure to observe can result in pump seizure.

### Procedure for Manual Cleaning

See elsewhere in this manual for procedures to dismantle and re-assemble the fluid contact parts.



### ATTENTION



Take care not to scratch or damage pump parts. One part of the seal faces remains in the rotor when it is removed. Be extremely careful not to damage this seal face.

**DO NOT** use steel abrasive wool or brushes on fluid wetted surfaces as particles may become embedded in the surface and cause corrosion. Use suitable cleaning agents in accordance with their manufacturer's instructions regarding temperatures, dilutions, skin contact precautions and other safety information.

Thoroughly clean all fluid contact surfaces and rinse as required.

As a minimum it will be necessary to remove the end cover and rotors. Re-assemble the pump in accordance with this manual.

## 5.2 STERILIZING IN PLACE (SIP)

It is possible to pass steam through the complete assembled system to sterilize the internal surfaces without dismantling the pump.

To achieve 100% sterility, it is important to steam through for a period long enough for the coldest part of the system to reach the correct temperature and hold for the time period required to kill off the organisms.

### Procedure for Sterilizing In Place (SIP)

If using chemical sanitizers, follow the guidelines as for CIP above. If using steam, the pump specification must be chosen at the time of selection noting:

- EPDM elastomers offer best resistance to repeated steam contact but will need to be changed periodically.
- PTFE (Teflon) is least suitable for steam contact - PTFE end cover joints may need to be replaced every time the pump is sterilized.
- For more information contact Packo.

The pump should be mounted with the port axis vertical to avoid collecting liquid pools.

- Thoroughly clean the pump and process lines prior to sterilization.

- Pass clean, wet steam through the system until all component temperatures have stabilized. Steam must be free of scale, rust and particles - a filter may be necessary. Typically steam will be at 121°C (250°F) and 1 bar (15 psi). Soak time, to bring the pump up to temperature is typically 20 minutes but this should be established, e.g. using thermocouples, as the required soak time will vary with individual installations.



### ATTENTION

Do not rotate the lobe pump during this heating phase.



### ATTENTION

Do not loosen or remove any pump components or pipe connections during steam sterilization as escaping steam may cause serious injury.

- Continue to pass wet steam through the lobe pump and process lines during the hold time. Hold time will be determined by the user to achieve desired level sterility. Typically this will be between 20 and 60 minutes.
- The lobe pump should not be rotated during this hold time unless absolutely essential to achieve sterility, due to increased risk of pump seizure. All pump components will normally reach the desired temperature by thermal conduction without rotating the pump.



### ATTENTION

- If essential, the lobe pump can be rotated by hand during the hold time - beware of danger of hot surfaces – or at a maximum of 50 rpm but only if the pump is fitted with either:
- Single carbon/silicon carbide seals - or -  
Flushed or double seals provided a liquid flush, i.e. Condensate is connected and operating at a pressure above the steam pressure within the pump during SIP.



### ATTENTION

If the lobe pump is fitted with single silicon carbide/silicon carbide seals it must not be rotated during hold time as the seal faces can



### ATTENTION

bind together.

- At the end of the hold time, the pump must be allowed to cool naturally or can be purged with sterile air/inert gas.



### ATTENTION

The pump must not be rotated during cooling.

- Do not allow cool liquid to enter the lobe pump before pump temperature has fallen to 60°C (140°F) or lower.

If the pump is fitted with silicon carbide/silicon carbide seals, flood it with liquid to lubricate the seals before rotating it.

## 6 INSPECTION AND REPAIR

HP & LH pumps need no adjustment during normal operation. It is advisable though to check oil levels and inspect pump head components (especially seals and joints) periodically so that they may be cleaned or replaced before they fail in service.

All primary fluid contact components of the pump can be inspected and serviced without removing the pump rotor case from the bearing carrier and without removing either the pump or drive unit from the baseplate, as follows:



### ATTENTION - For your safety:

Before commencing any repair or inspection, isolate the power to the pump and drive motor, depressurize, drain and isolate the pipework, seal flush and temperature control jackets (if fitted).

### 6.1 END COVER

#### Removal

Before removing the end cover (122), ensure the pump & drive are isolated; the pump is cool enough to safely touch, drained of any fluids (take special care with hazardous fluids) and ensure that pump, seal flushing system and jackets are isolated and depressurized.

If the end cover is fitted with a pressure relief valve refer to (END COVER RELIEF VALVE)

Proceed as follows:



### ATTENTION

The end cover is heavy; take care to support it when removing the bolts (123).

- Remove the bolts (123) and remove the cover. If it is stuck tap carefully sideways with a soft hammer, do not lever off.
- **DO NOT** damage the face of the cover nor the seal ring: place face upwards on a clean surface.

#### Re-fitting:

- Place the O-ring (120) in the end cover groove, ensuring that it seats evenly. (Figure 17)

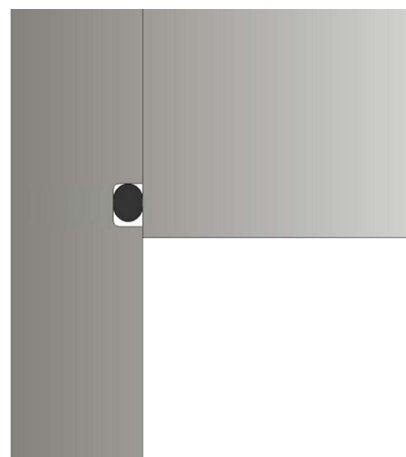


Figure 17 – HP & LH end cover

### 6.2 ROTORS

#### Removal:

Disconnect the pump from the motor drive. Remove the end cover (See 6.1 END COVER)

- The rotors are secured by special slotted screws (59) and sealed by O-rings (58).
- Lock the pump rotors with a soft spacer (Figure 18) - a plastic block (180) is provided with the pump for this purpose.

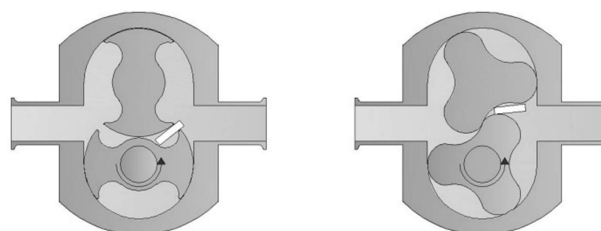


Figure 18 - Loosen the rotor bolt (bottom rotor)

- Use only the special tool (181) supplied to loosen and retighten. Both screws have a right-hand thread.
- Withdraw the rotors carefully to avoid seal damage by contact between the shaft ends and seals faces which are located on the back of the rotors.
- Make note of which shaft the rotor fits to, so that you can fit the rotor back onto the correct shaft. (preventing mixing of matched seal faces)
- Note: When removing the rotors the static seals can, on occasion, be pulled out of their seal bores. This does not damage the seal but extra care must be taken not to drop the static seal face.

### Re-fitting:

- With the seal and cup rubber correctly fitted within the back of the rotor (see 6.3 PRIMARY SEALS) clean and dry the seal faces with a soft tissue before re-fitting. Do not lubricate the seal faces.
- Slide the rotor assemblies onto their respective shafts. When fitting each rotor it should slide freely on its drive splines. (HP32 & 34 scimitar rotors locate on flats)
- Lock the rotors using a soft spacer (Figure 19) - a plastic block (180) is provided with the pump for this purpose.

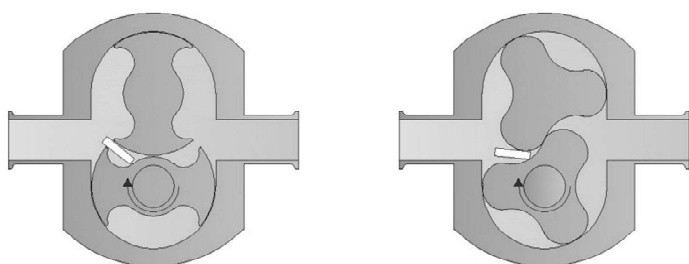


Figure 19 - Tighten the rotor bolt (bottom rotor)

- Lubricate the O-ring (58) and fit into the rotor bore in the front of the rotor and refit the screw.
- Retighten using the special tool provided to the torque specified in Table 4 - Rotor torque.

Retighten using the special tool provided to the torque specified in Table 4.

Pump Size	Fixings	Torque
HP 32/34	Rotor Screw	18Nm
HP 42/44	Rotor Screw	55Nm

HP 52/54	Rotor Screw	55Nm
HP 62/64	Rotor Screw	100Nm
LH 72/74/76 (tri-bolt)	Hygienic Cap	40Nm
	Bolts	50Nm

Table 4 - Rotor torque

## 6.3 PRIMARY SEALS

When the rotors have been removed (see 6.2 ROTORS) the primary seals can be inspected for wear, cracks, chips, scratches or signs of burning caused by running dry.

Inspect rubber joints for damage or deterioration. Clean the seal faces with soft lint-free tissue before re-assembly.

It is advisable to purchase and fit new elastomer trim kits from your local distributor, when removing and re-fitting seal faces. As a precaution it is also advisable to have a spare set of seal faces available as these parts are very brittle and are easily broken.

### To dismantle mechanical seals:



### ATTENTION

Ensure that you DO NOT scratch any components of the pump, as this will compromise the cleanability of the pump.

### HP 4-6

- Carefully remove the static seal seats (80) from their bores in the rotor case (51). This is done by using the special seal removal tool (182) supplied with the pump. Carefully insert the seal removal tool between the outside diameter of the static seal seat and the bore in the rotor case. (Figure 20)

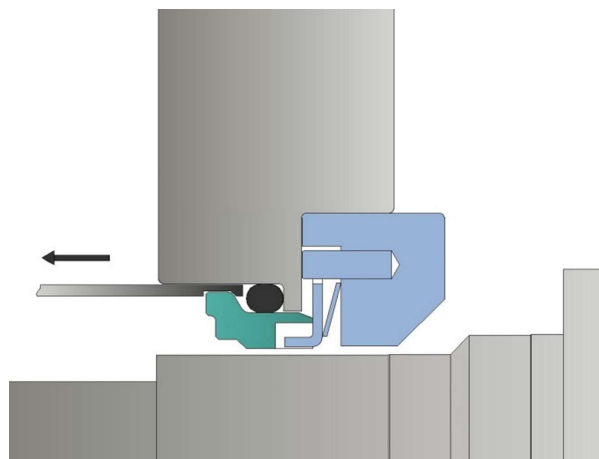


Figure 20- Seal seat removal



## HP32 & HP34 Pumps



### ATTENTION

**Note:** Double mechanical shaft seals are not available on the HP3 size pumps

- Pull the static faces (80) from their bores in the rotor case (51), removing the joint ring (83) with each seal face. Take care not to scratch or damage the smooth face of the seal.
- If you intend to re-use these faces keep each seal with its respective shaft to ensure correct mating of mating of seal faces on reassembly - you may wish to label the components.
- Only remove the seal seat from the back of the rotor (56 & 57) if you intend to fit a new seal or cup rubber (83).

To remove the seal seat from the back of the rotor a special tool is required. This tool needs to be manufactured to the dimensions shown in Figure 23.

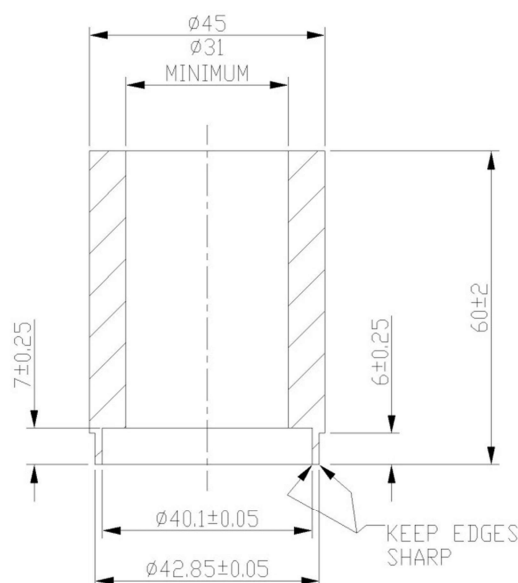


Figure 23 - Sleeve dimension

- Press the sleeve down onto the visible edge of the cup rubber. This will force the rubber down into the seal bore in the rotor. The seal face will be pushed out of its bore.

Do not lever out the seal face with screwdrivers or similar tools as seal materials are brittle and are easily damaged or broken.

If the seal face is to be re-used, note which way up it was fitted - seal faces are not reversible.

### Fitting Mechanical Seals:

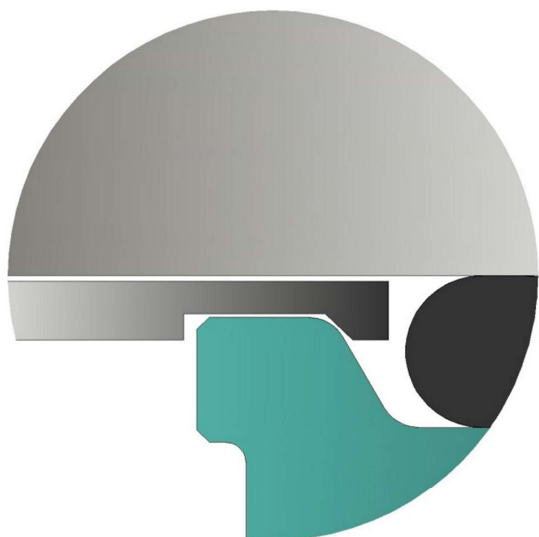


Figure 21 - Seal seat removal hooked end

- Push back the O-ring with the end of the tool and rotate the tool by 90 degrees, until the hooked end locks in position behind the seal seat. (Figure 20 & 24)
- Working the tool gently around the circumference of the seal, carefully pull the seal face out.
- Take great care not to scratch or damage the smooth face of the seal.
- Keep each seal with its respective shaft to ensure correct mating of the seal faces on re-assembly.
- The joint ring (83) may come out with the seal face. If not, then remove it from the rotor case bore and keep it together with the seal face.
- You may wish to label the components.

**Note:** static seal seats can also be accessed from the back of the rotor case after removing the rotor case and seal housings (see 6.6 SEAL HOUSINGS).

- Only remove the rotary seal seat (80) from the back of the rotor (56) if you intend to fit a new seal or L cup rubber (83). Gently prise out the seat from the rotor using two soft levers to avoid scratching rotor and damaging seal face. (Figure 22).

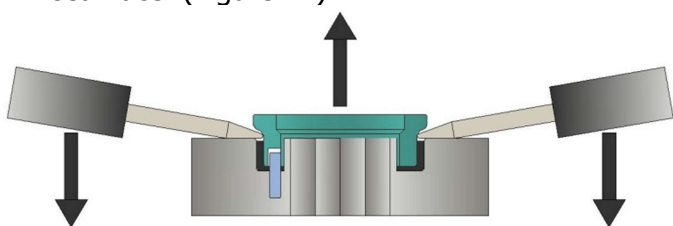


Figure 22 - Seal removal from rotor

**Note:** if refitting previously used seal faces ensure that rotary and static faces are in their original pairs.

#### HP4-6



#### ATTENTION

Fit the seal face with the narrow face track into the rotor case. The seal face with the wide face track should be fitted into the rotor.

- Fit the O-ring (83) to the static primary seal face and lubricate the bore in the rotor case with a suitable lubricant compatible with the pumped fluid and the elastomer.
- **DO NOT** use mineral-oil based lubricants on EPDM joints.
- Align slots in the seal face with tabs of drive plate in the seal housing; a small cut-out is provided so one drive tab can be seen (Figure 24).

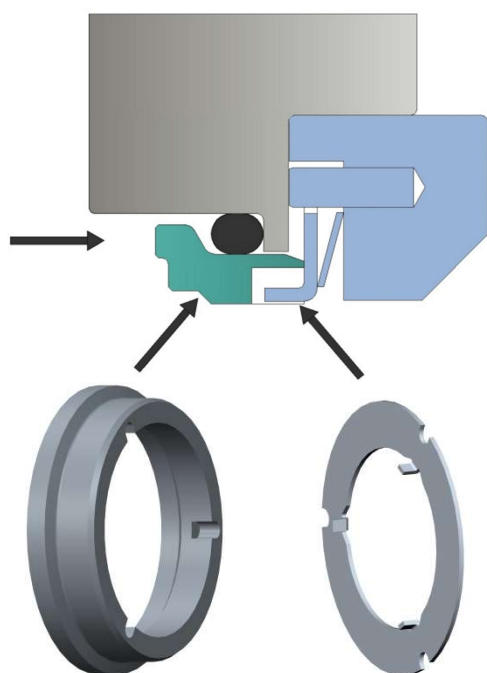


Figure 24 - Fitting stationary seat

- Push each seal seat in straight; when correctly fitted, seal seats should slide freely against the resistance of their springs.

Undue pressure is not required or recommended as seals are precision components. Be sure not to damage the O-ring (83), if difficulty is experienced put the O-ring into the rotor case bore then push the seal seat into the bore.

**Note:** if the rotor case has been removed (see

6.7 ROTOR CASE), static seal seats should be inserted into the rotor case, before mounting on to bearing housing.

- To fit the seal seat to the rotor (56), first insert L cup rubber (83) into the rotor (DO NOT lubricate), ensure alignment with the drive pin. (Figure 25).



Figure 25 – Align the L cup to the rotor drive pin

- If the PTFE trim is fitted, insert the rubber washer first followed by the PTFE sleeve. Note that the sleeve is slightly tapered and will be easier to fit if the narrow side is inserted first. Then lubricate the outside diameter of the seal seat.
- Align the rotor drive pin with one of the three slots in seal seat.
- Engage the leading edge of the seal seat into the cup rubber or PTFE sleeve. Push down evenly until the seal seat rests squarely on the bottom of the seal bore in the rotor.
- **DO NOT** damage the seat face.
- When correctly fitted, the seat is parallel with the back face of the rotor and must not be tilted. Any "run-out" of the seat will cause leakage of the seal.
- Assembly of the seal is now complete.
- Carefully clean all the seal faces with a soft lint free cloth and to remove all dust and grease.
- It may be necessary to use a compatible solvent to remove oil or grease.
- It is not normally necessary to remove the seal housings (86) from the back of the rotor case except to check the condition of the springs (82) and drive plates (81).
- If re-fitting the seal housings, align the 3 slots in outer edge of drive plate with the 3 pins. When fitted, ensure the drive plate can slide freely against the spring pressure. (see 6.6 SEAL HOUSINGS)

#### HP3 size pumps:

- Check the coil springs are in place in the seal housings.
- Fit the Quad ring (83) to the seal face and lubricate the bore in the seal housings with a suitable lubricant compatible with the pumped fluid and process. Ensure the Quad ring does not roll during fitting.
- **DO NOT** use mineral-based lubricants on EPDM elastomer joints; silicone grease is suitable.
- Align one slot in the rear of the static seal face with the pin in the seal housing and push the face back firmly against the coils springs. It should be free to 'spring' backwards and forwards.
- To fit the seat to the rotor, first fit a new cup rubber (83) to the seal face. Ensure the seal face is the correct way round, i.e. the smooth working face exposed.

**Note** – the back (non-working) face of the seal is identified with a groove or white mark.

- Lubricate the outside diameter of the cup rubber with a suitable lubricant (As noted previously), and press the face evenly into the rotor.
- Use a soft sleeve made from Nylon, as shown in Figure 23, and fit it into the end of the tool as shown in Figure 26. Alternatively use your fingers to do this in order to avoid damage to the seal face.

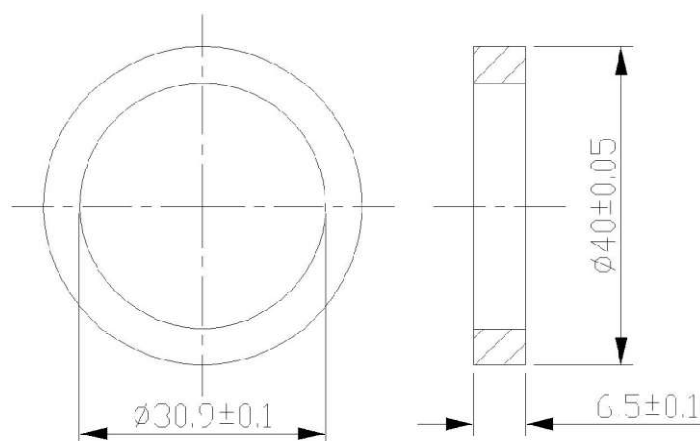


Figure 26 - L Cup insertion tool

- When correctly fitted the seal face should be 'flush' with the back face of the rotor and **MUST NOT** be tilted. Any 'run-out' of the seal face could cause seal leakage.
- The cup rubber **SHOULD NOT** stand 'proud' of the back face of the rotor.
- 

## 6.4 MECHANICAL SHAFT SEALS - SINGLE FLUSHED

Pumps fitted with flushed seals have lip seals fitted in order to retain a flushing or barrier fluid.

To service lip seals it is necessary to remove the rotor case (51) (6.7 ROTOR CASE)

### Removal:

- Remove the seal housings (89) from the back of the rotor case. (see 6.6 SEAL HOUSINGS).
- Press the lip seals out of the housings.
- Check that the surface of the shaft where the lip seal runs is smooth and is not grooved.

**Note for HP32 and HP34 models** Check that the surface of the sleeve where the lip seal runs is smooth and not grooved.

Where necessary replace the sleeve by lightly heating the sleeve which will break the bond of the adhesive. With a soft lever, prise the sleeve off the shaft.

### Re-Fitting HP 4-6:

- Push the new lip seals into the housings. Assemble the spacer collar, wave spring and drive plate as shown in Figure 30. (Also see 6.6 SEAL HOUSINGS)
- When re-fitting the seal housings, align the 3 slots in the outer edge of the drive plate with the 3 pins. When fitted, ensure the drive plate can slide freely against the spring pressure.
- You may wish to insert the O-ring (83a) and static primary seal seats at this point (see 6.3 PRIMARY SEALS).
- When re-fitting the rotor case to the bearing housing, take care that the lip seals and mechanical seals (80) are not damaged by the shaft splines or shaft ends.

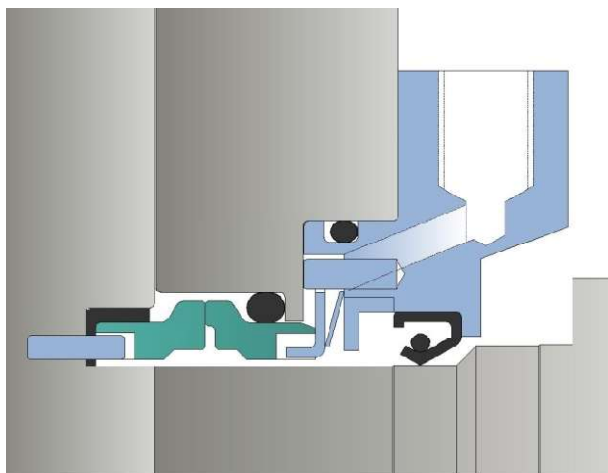


Figure 27 - Single flushed mechanical seal

### Re-Fitting HP3:

- Push the new lip seals into the seal housings.
- Fit the O-rings into the grooves in the outside diameter of the housings
- Assemble the seal housings (89) into the rear of the rotor case (51) and clamp in position using the four clamp washers (84) and screws (85).
- If the shaft sleeves have been removed, fit the new sleeves. These will need to be glued to the shaft by spraying the area of the shaft where the sleeve is to fit and also the inside bore of the sleeve itself with LOCTITE TM Activator 7471.
- Then smear a generous amount of LOCTITE TM 635 to the area of the shaft where the sleeve is to fit. Slide the sleeves onto the shafts up to the shoulder on the shaft; note that the sleeve cannot be pushed fully against the shoulder because of the radius in the corner. The sleeve should be fitted with the chamfered end towards the front of the pump.
- Rotate the sleeve on the shaft to ensure that the LOCTITE TM forms a seal as well as a bond. Leave for 5 minutes to allow the bonding process to occur.
- Continue by following the instructions in section 6.6 for assembly of the mechanical seal.

## 6.5 SECONDARY MECHANICAL SEALS – DOUBLE

(Refer to 6.3 PRIMARY SEALS - for servicing of primary Seals.)

Pumps fitted with double seals have secondary seals in order to retain a flushing or barrier fluid.

To service primary seals refer to 6.03 Primary Seals.

To service secondary seals it is necessary to remove the rotor case (6.7 ROTOR CASE).

**Note:** Not available on HP32 and HP34 pumps.

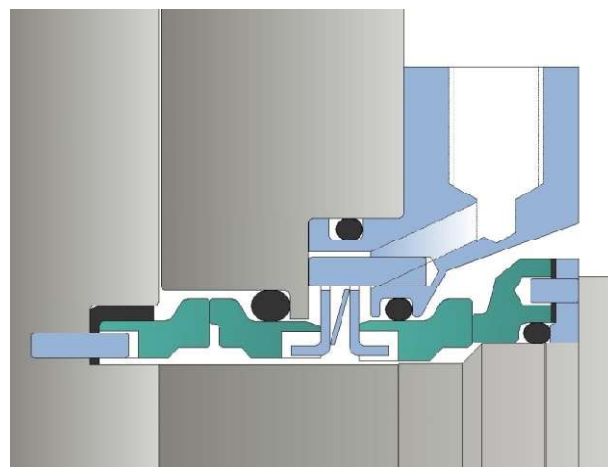


Figure 28 - Double mechanical seal

### Removal:

- Remove the static faces from the housings. (95)
- If fitting new O-rings (93) prise them out of the housing (95).
- Pull the rotary seats (92) off of their shafts. Take care not to scratch or damage the smooth faces of the seals. Keep each seal with its respective shaft to ensure correct mating of the seal faces on re-assembly – you may wish to label the components at this stage.
- If fitting new O-rings (93) prise those out of their seal face (92). It is not normally necessary to remove the seal housings (95) from the back of the rotor case except to check condition of springs (82) and drive plates (81) (See 6.6 SEAL HOUSINGS).

### Re-Fitting:

- To re-assemble, place the O-ring (93) in the double seal housing (95), lubricate the outside of the static seat with a suitable lubricant compatible with the barrier fluid. Align the slots in the seal face with tabs of drive plate (94) in the seal housing, (Figure 28) and push the seat fully in. The seat should slide freely against the plate (94) and wave spring (82).
- If fitting double seals to a pump for the first time, e.g. retrofitting a single seal pump, gently tap or press the support ring (92b)

- square up against the shoulder on each shaft.
  - Fit the soft washer (92a) in place on the support ring.
  - Fit the O-ring (93) to the rotary seal seat (92). Gently push the seal seat squarely on to the shaft, aligning the hole in the rear of the seal face with the pin on the support ring.
  - Clean the seal faces with a soft lint-free tissue to remove any grease or dust - do not lubricate. Refit the rotor case taking care that the shafts do not damage secondary seal faces.
- (6.7 ROTOR CASE)

## 6.6 SEAL HOUSINGS

It is not normally necessary to remove the seal housings (86, 89 or 95) from the back of the rotor case except to check the condition of the springs (82) and drive plates (81).

If required to do so, proceed as follows:

**Note:** Seal housings vary for single (86) flushed (89) & double seals (95) (see 3.11 SEALS AND FLUSHING).

### Removal:

- Remove the end cover (see 6.1 END COVER), rotors (see 6.2 ROTORS), rotor case (6.7 ROTOR CASE).
- Position the rotor case (51) face down on the clean smooth surface, seal housings (86, 89 or 95) uppermost. Taking care not to damage the front of the rotor case.
- If double seals are fitted remove the static seal seats (92) from the housings (95), keeping mating seal faces together. You may wish to label the components. (6.5 SECONDARY MECHANICAL SEALS – DOUBLE).
- Loosen the screws (85) by half a turn and rotate eccentric clamp plate (84) by half turn.
- Carefully withdraw the seal housings. Note the position of the drive plates, wave springs and backing rings.
- Inspect the components for wear, replace as required.

### Re-Fitting:

For single flushed seal housings refer to (6.4 MECHANICAL SHAFT SEALS - SINGLE FLUSHED) for lip seal replacement.

- **Primary or Single Flushed Seal** - Assemble

the wave spring (82) followed by the drive plate (81). Ensure that the 3 slots on the outer edge of the drive plate locate on the 3 pins in the housing. Drive plate should be assembled with drive tabs side last.

- **Secondary Mechanical Seal** - Assemble one drive plate (94) with drive tabs side entering first and the 3 slots on the outer edge locating on the 3 pins in the housing. Assemble the wave spring (82) followed by the second drive plate (81).
- Ensure that the 3 slots on the outer edge of the drive plate locate on the 3 pins in the housing. The drive plate should be assembled with drive tabs side last i.e. opposing direction to first drive plate.
- For flushed or double seals, position O-ring (91) on to the step on the outside diameter of the seal housing.
- Holding the seal housing (86), drive plate(s) (81 & 94) and wave spring (82), together; position the housing assembly into the bore on the backside of the rotor case. Fit it flat with the rear face of the rotor case.
- Hold in position and rotate the clamp plates (84) half a turn in order to retain the housing. Tighten the screws (85) finger tight only.
- Ensure the drive plate(s) is free to move.
- Tighten the housing screws to a torque of 15Nm.

## 6.7 ROTOR CASE

- Disconnect the process pipes and any flush/barrier connections; first ensuring fluid is not under pressure.
- The rotor case can be removed after withdrawing the end cover (see 6.1 END COVER), the rotors (see, 6.2 ROTORS)
- Remove four hexagon socket screws (52) holding the rotor case (51) to the bearing carrier (1).

**Note** that the rotor case is dowelled and can only be re-fitted one way round.



### ATTENTION

Secure the pump onto a workbench or baseplate before removing the rotor case, as the gearbox will tip backwards without the rotor case being in position.



### ATTENTION

The rotor case is heavy; ensure that it is



supported before the four hexagon socket screws are removed.

If primary or secondary static seal seats (80) are still fitted to the rotor case take care not to damage them on the shaft ends (24 & 25). If single flushed seals are fitted take care not to damage them on the shaft splines or shims (30).

### Re-fitting:

- Refit any seal housings removed (6.6 SEAL HOUSINGS) to the rotor case.
- Refit the rotor case (noting dowel for rotation) and torque the four hexagon head socket screws (52) to the torque specified in Table 6 – Rotor case torque table.

Pump Size	Fixing	Torque Nm
HP 32/34	Rotor case Bolt	8
HP 42/44	Rotor case Bolt	10
HP 52/54	Rotor case Bolt	20
HP 62/64	Rotor case Bolt	20
LH 72/74/76	Rotor case Bolt	50

Table 5 – Rotor case torque table

## 6.8 ROTOR CLEARANCE - CHECKING & ADJUSTMENT

HP & LH pumps have very small, carefully controlled clearances between rotors and rotor case. Scimitar meshing clearances and Radial clearances (shown a & b) are factory set and cannot be changed. Axial clearances and Tri lobe meshing clearances (shown c and d) are adjustable if incorrect. (Figure 29, 30, 31, 32 & Table 6).

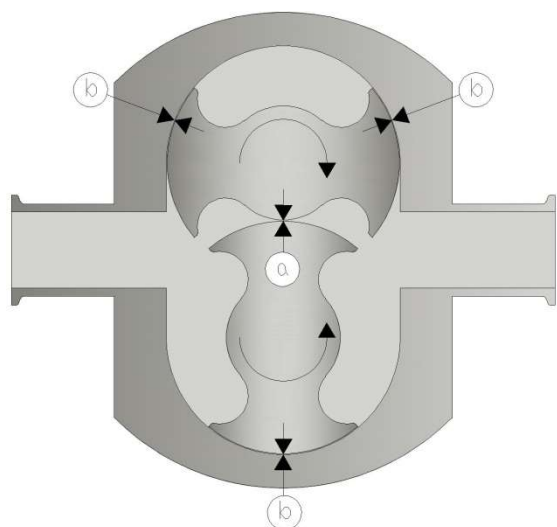


Figure 29 - clearance measuring

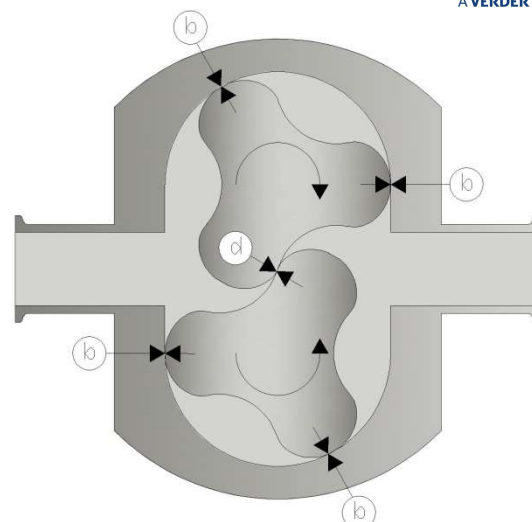


Figure 30 - Shim / clearance measuring

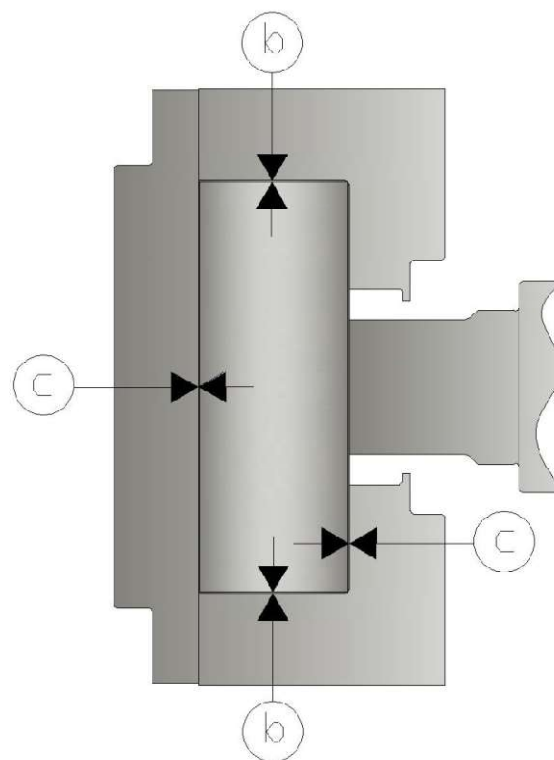


Figure 31 - Shim / clearance measuring

Pump model	Rotor code	Front: rotor to front cover	Radial: rotor to rotor case	Mesh: min	Mesh: max
HP32	TLHE	0,04	0,06	0,13	0,25
	TLHP	0,06	0,08	0,13	0,25
	SCHE	0,04	0,06	-	-
	SCHP	0,06	0,08	-	-
HP34	TLHP	0,09	0,09	0,15	0,25
	SCHP	0,07	0,09	-	-
HP42	TLHE	0,075	0,075	0,13	0,28
	TLHP	0,16	0,21	0,18	0,33
	SCHE	0,075	0,075	-	-
	SCHP	0,13	0,21	-	-
HP44	TLHP	0,21	0,25	0,33	0,53
	SCHP	0,13	0,21	-	-
HP52	TLHE	0,125	0,195	0,13	0,33
	TLHP	0,17	0,25	0,18	0,43
	SCHE	0,125	0,125	-	-
	SCHP	0,17	0,25	-	-
HP54	TLHP	0,24	0,32	0,23	0,46
	SCHP	0,15	0,25	-	-
HP62	TLHE	0,2	0,31	0,2	0,41
	TLHP	0,25	0,5	0,28	0,53
	SCHE	0,15	0,2	-	-
	SCHP	0,25	0,45	-	-
HP64	TLHP	0,45	0,63	0,28	0,53
	SCHP	0,25	0,45	-	-
LH72	SCHE	0,15	0,23	-	-
	SCHP	0,24	0,44	-	-
LH74	SCHP	0,24	0,59	-	-
LH76	SCHP	0,24	0,44	-	-

Table 6 - Rotor clearances (all values in mm)

### Axial Clearance: Scimitar and Tri Lobe

- With the pump assembled, the end cover (122) removed (see 6.1 END COVER), and the rotors (56) (see 6.2 ROTORS) and rotor case (1) (6.7 ROTOR CASE) fully secured to the correct torques.
- Measure the rotor front end clearances (c) using a depth gauge or feeler gauge and straight edge.
- If the clearance is incorrect (to Table 6 – Rotor clearances) remove the rotors (56) (see 6.2 ROTORS).
- Remove the O-rings (31) and shims (30), the shims are cut to allow them to slide over the shaft.
- If mechanical shaft seals are fitted take great care not to scratch, chip or damage the seal faces.

- Measure the thickness of the shim pack for each shaft and calculate the thickness of the shim to add or remove on each shaft to give the front clearance specified in Table 6 –Rotor Clearances.
- Shims are available in increments of 0.025 mm (0.001 inch).
- To fit the shims open them slightly and slide onto the shaft up to the shoulder (A) (Figure 32).

**Note:** On HP32 and HP34 tri lobe models splined shafts are used with shim spacer rings (30a). Shims are fitted between the shaft shoulder and shim spacer ring.

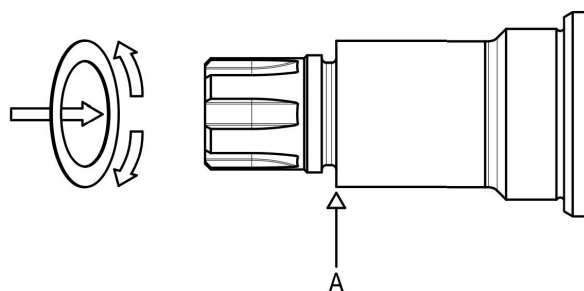


Figure 32 - Fitting shims

**Note:** New shims are not cut; this will need to be done with scissors prior to fitment if required.

- Fit the shims and retain them with the O-ring (31).

**Note:** O-ring not used on HP32 and HP34 models

- Refit the rotors and tighten the retaining bolts (59) to the correct torque (see 6.2 ROTORS). Re-check end clearance and re-adjust if necessary.

Check the condition of the bearings and the pre-load if any side-to-side movement of the rotors can be detected or if the radial clearance is incorrect.

There is no adjustment for radial clearance - replace the shafts and/or bearings if worn.

### Meshing Clearance: Tri Lobe only

#### For Re-fitting or New Rotors:

- Gear nuts must be tightened to the correct torque before taking clearance measurements** (see 6.14 BEARING SET-UP)

#### AND PRE-LOAD)

- Align the rotors in the rotor case as per Figure 30
- Check the rotor to rotor meshing clearance (d in Figure 30, left of bottom lobe) on the first lobe and note it down.
- Turn the rotors 120° (clockwise on driving shaft rotor) and take the rotor to rotor meshing clearance (d in Figure 30, left of bottom lobe) on the second lobe and note it down.
- Turn the rotors 120° (clockwise on the driving shaft rotor) and take the rotor to the rotor meshing clearance (d in Figure 30, left of bottom lobe) on the final lobe and note it down.
- Turn the rotors 60° (clockwise on driving shaft rotor) and check the rotor to rotor meshing clearance (now on the right of bottom lobe) and note it down.
- Turn the rotors 120° (clockwise on the driving shaft rotor) and take the rotor to the rotor meshing clearance (On the right of bottom lobe) on the second lobe and note it down.
- Turn the rotors 120° (clockwise on the driving shaft rotor) and take the rotor to rotor meshing clearance (On the right of the bottom lobe) on the final lobe and note it down.
- This will give you the meshing clearance of all lobes.
- Mesh Clearances of Left and Right of Lobes are shown in Table 7.
- To obtain the correct meshing clearance of the lobes, shims (30a) need to be added or removed in front of a gear.
  - To increase the gap on the left hand side of the lobes add shims to the driving shaft or remove shims from the driven shaft.
  - To decrease the gap on the left hand side of the lobes remove shims from the driving shaft or add shims to the driven shaft.
  - To move the meshing clearance 0.025mm you need to add or remove approximately 0.075mm of shim to the gears.

#### For Spot Checking Rotors that have Run:

- Note down all meshing clearances as shown above for re-fitting or new rotors.
- Check the rotor to rotor meshing clearances are between the values shown in the Mesh

setup columns in Table 6.

- If the values are not within the limits remove the rotors and re-fit using the procedure stated in the section For Re-fitting or New Rotors.

## 6.9 END COVER RELIEF VALVE

Refer to chapter 8 EXPLODED DIAGRAMS



### ATTENTION

New relief valves are not supplied factory set. This pressure setting should be done when the valve is fitted to the pump. (See 3.13 END COVER RELIEF VALVE)

- Remove the relief valve end cover assembly from the pump. Before doing so make a note of the position of the 'Direction of Flow' arrow.
- Remove the adjusting screw (135).
- Hook the spring (132) out from the top of the housing (133). Alternatively turn the valve upside down and tip the spring out.
- Remove the 2 screws (136) and remove the housing (133).
- The valve seat (128) and diaphragm (129) will come off of the end cover (125) together with the housing. To disassemble these, tap the end of the guide pin (134) with a soft tool. The valve seat, diaphragm and piston/guide pin assembly should now separate from the housing.
- Remove the O-ring (126) from the groove in the valve seat.

### Inspection:

- Inspect the condition of the diaphragm. Look for splits, cracks or other signs of wear and fatigue. Replace if necessary.
- Inspect the conical end of the piston (131) around the screw thread and around the outside edge of the cone to ensure there are no sharp edges or burrs.

Refer to chapter 8 EXPLODED DIAGRAMS

### Re-Fitting:

- Lay the end cover (125) on its face. On a clean surface, taking great care not to scratch the internal face
- Fit the O-ring (126) into the groove in the face of the valve seat (128). Use a suitable grease to 'stick' the O-ring in the groove.



- Turn the valve seat upside down and place the seat onto the end cover with the O-ring towards the end cover i.e. the conical face uppermost.  
Position the 2 screw holes in the valve seat over the corresponding threaded holes in the end cover.



### ATTENTION

Ensure that the X marked on the side of the seat is aligned with the X on the end cover.

- Place the diaphragm onto the seat.
- Pumps fitted with Viton or PTFE pump head elastomers use a PTFE faced perfluor-elastomer diaphragm. Ensure that the PTFE side is face down i.e. PTFE face is in contact with the valve seat.
- Hold the housing (133) upside down and slide the piston/guide pin assembly into the housing, guide pins first. Place a finger into the thread end of the housing and hold the guide pin by pushing on its side. Turn the housing over so that the widest end is lowermost.
- Place the housing / piston / guide pin assembly over the diaphragm / valve seat / end cover assembly such that the 2 holes align with the holes in the diaphragm.
- Push the 2 screws (136) through the holes in the housing so that they locate into the threaded holes in the end cover.
- Tighten the screws enough to hold the assembly together. (8Nm)
- Fit the spring and adjusting screw and tighten the screw until it contacts the spring.
- Tighten the 2 retaining screws (136) to a torque of 15Nm.
- The valve is now assembled and can be re-fitted to the pump.



### ATTENTION

Ensure that the 'Direction of Flow' arrow is in the previously noted position.

- Reset the valve to the correct pressure (See 3.13 END COVER RELIEF VALVE).

## 6.10 THERMAL JACKET – END COVER

Refer to chapter 8 EXPLODED DIAGRAMS

Ensure that the liquid feed to the jacket is

switched off before attempting to service it.

- Dismantle the jacket (144) from the cover (143) by removing the screw (147) from the centre of the jacket
- Remove the inner O-ring (146) from the groove around the screw and the outer O-ring (145) from the groove around the outside edge of the jacket.
- Replace the O-rings and re-fit the jacket.
- Tighten the screws to a torque of 15Nm.

## 6.11 THERMAL JACKET – PUMP HEAD

Refer to chapter 8 EXPLODED DIAGRAMS

Ensure that the liquid feed to the jackets is switched off before attempting to service them.

- Dismantle the two jackets (139) from the end cover (138) by removing the screws (141).
- Remove the O-rings (140) from their grooves.
- Replace the O-rings and re-fit the jackets.
- Tighten the screws to a torque of 15Nm.

## 6.12 Bearing housing - inspection & repair

Power input to the pump is via the drive shaft (24). The gearbox has two contra-rotating shafts (24 & 25), supported by taper roller bearings (4 & 5). The shafts are synchronized by a pair of precision cut gears (6) that distribute power between the drive shaft (24) and driven (lay) shafts (25).

HP and LH pump gearboxes have been designed for easy inspection and maintenance.

### Inspection:

Bearing housing (1) and gearbox internals can be inspected by removal of the gear cover (11).

- Disconnect the pump from the drive and remove the shaft coupling.
- Drain the lubricating oil from the pump gearbox via the drain plug (14).
- Remove two gear cover securing screws (18) and plastic sealing washers (19).
- Remove the drive shaft key (29) and gear cover (11), taking care not to damage the drive shaft oil seal on the drive shaft key-way.

Preliminary inspection can now be carried out without further dismantling; i.e. condition of timing gears or movement in the bearings.

- If all is found to be satisfactory, refit in reverse order.

### Repair:

To repair the bearing housing assembly you will need the parts contained within the appropriate Repair Kit, in addition to any new gears (6) or bearings (4 & 5) required. Contact your distributor for details.

## 6.13 GEARBOX SHAFTS, GEARS AND BEARINGS

If the shafts are to be removed for any reason, label all components including bearing outer races, shims etc. and keep in their correct positions.

With the pump disconnected from its drive.

- Remove the rotor case (see 6.7 ROTOR CASE), drain oil via the plug (14) and remove the gear cover (11).
- Bend down the tab washers (7) which lock the gear nuts (8).
- Before loosening the gear nuts (8) lock the rotors on the shaft using the plastic block supplied for this purpose. Loosen the gear nuts (8) using a C-spanner.
- Remove the gear nuts (8), tab washers (7), timing gears (6) and drive shaft keys (28), from the shafts.

**Note:** On HP3 sized pumps there is a second tab washer (7a) and gear nut (8a) between the gears (6) and the rear bearings (4)

- Using a light press or soft hammer, drive out the shafts (24 & 25) towards the front (rotor case end) of the bearing housing (1) (Figure 33). This will push out the front oil seals (23).

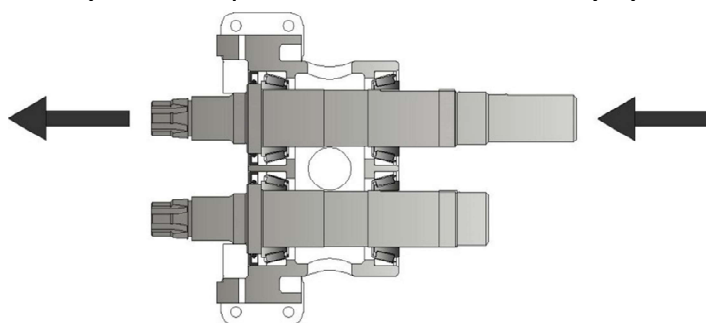


Figure 33 - Removing shafts

The inner race of the rear bearing (4) will slide off the shaft. Be careful that it does not fall off. Alternatively, prize out the front lip seals (23) first with a sharp tool. Take care not to damage the bearing housing or journals of the shaft during this operation.



**Stainless steel bearing housing option only:** The aluminum and stainless steel components of the bearing carriers are machined as an assembly and should never be dismantled.

- The outer races of the bearings (4 & 5) can be pulled out of the housing (1).
- To remove the inner race of the front bearing a press will be required.

### Re-Fitting:

Assemble in the reverse order, checking and re-adjusting the bearing pre-loads.

(6.14 BEARING SET-UP AND PRE-LOAD)

## 6.14 BEARING SET-UP AND PRE-LOAD

Each shaft is supported on 2 taper-roller bearings front (5) and rear (4) which are preloaded to prevent any end-float (sideways movement) of the shafts (24 & 25).

If any movement is detected in either shaft (side to side or axially) new bearings must be fitted (6.13 GEARBOX SHAFTS, GEARS AND BEARINGS) and correctly pre-loaded.

### Assembly of the shafts is as follows:



**SAFETY:** Bearings inner races require heating to 140°C (230°F). Protective gloves are essential.



### ATTENTION

- **USE GLOVES:** Heat only inner races of front bearings (5) and assemble onto the shafts (24 & 25) making sure they are square and pressed tight against the shaft shoulder, ensure bearings are in the correct orientation. (Figure 34)

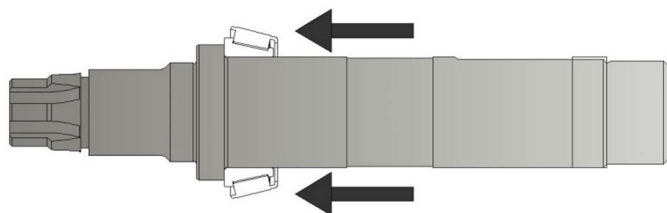


Figure 34 - Inner-ring fitment

- Press both front (5) and rear (4) outer races into the bearing housing, (Figure 35) making sure they are square and pressed tight against the bearing housing shoulder.

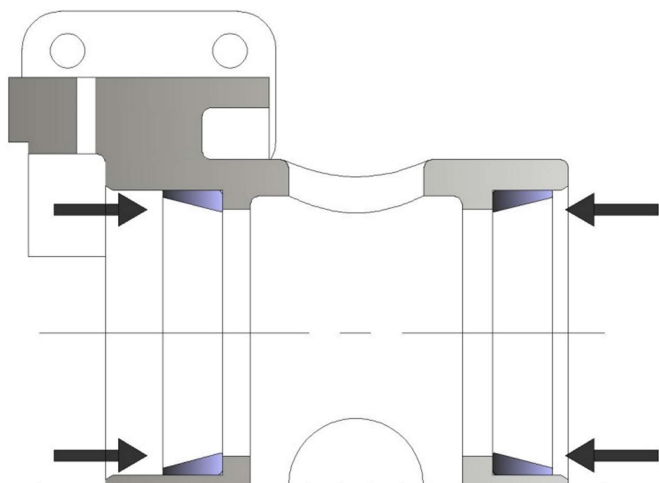


Figure 35 - Outer-ring fitment

**NOTE:** At this stage **DO NOT** put additional oil on bearings.

- Stand shafts (24 & 25) on their front face and lift the front of the bearing housing (1) over them sliding the inner races of front bearings (4) onto the shafts until the front inner bearing races are in light contact with their outer races.



### ATTENTION

- USE GLOVES: Heat inner races of rear bearings (4) and assemble onto the shafts (24 & 25) making sure they are square and pressed tight against the outer races in the bearing housing. Ensure bearings are in the correct orientation.
- Put the bearing housing assembly (with shafts in position) onto its feet.
- Fit the gear drive key (28), gear (6), tab washer (7) and gear nut (8). Tighten the gear nut (8) by hand to hold the assembly in place, taking-up any end float.

**Note:** To stop the shafts spinning the rotors can be attached to the front of the shafts so a plastic block can be placed between them as if you were tightening the rotor screws. Alternatively a plastic block can be inserted between the gears to stop the rotors turning.

For all HP3, HP7 and HP8 sized pumps do not fit the gear drive key (28), gear (6), tab washer (7) and gear nut (8) yet. Use the second tab washer (7a) and gear nut (8a) between the gears (6) and the rear bearings (4).

- Rotate the shaft a minimum of 4 times and tighten the gear nut (8) again by hand. (Bearing nut (8a) for HP3 models)
- Rotate the shaft a further 4 times, tighten the gear nut again by hand and then tighten the nut a further quarter turn, using the C-Spanner. (Bearing nut (8a) for HP3 models)
- Rotate the shaft 4 more times and torque the gear nut (8) (or bearing nut 8a for HP3 models)
- Repeat two-three times until no further tightening of the gear nut is perceived.

Pump Model	Bearing nut Torque Nm	Gear nut Torque Nm
HP32	23	40
HP34	23	40
HP42	n/a	50
HP44	n/a	50
HP52	n/a	100
HP54	n/a	100
HP62	n/a	150
HP64	n/a	150
LH72	200	150
LH74	200	150
LH76	200	150

Table 7 - Bearing and Gear nut torque settings

**NOTE:** when fitting the second gear, align gear timing marks. (Figure 36)

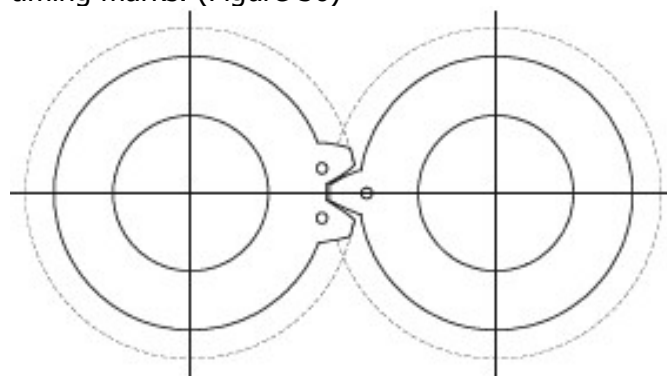


Figure 36 - Gear timing marks



## **ATTENTION**

Do not fit gear (6) on HP3 and LH7 models.

**Note:** For HP3 and LH7 models.

- Once bearing nuts are to the correct torque in Table 8 repeat the stages in the 7 bullet points above to fit the gear drive keys (28), gears (6), tab washers (7) and gear nuts (8). Ensure that the timing marks (Figure 36) are aligned.

Once the Shaft, Bearing and Gear Nut assembly is complete the bearing housing can be rebuilt as follows:

- Front oil seals (23) should be pressed in, until they are flush with the front face of the bearing housing (1). Take care not to curl/damage the lip or displace the gaiter spring on the shaft.
- Ensure they are square to the shaft (not tilted).
- Assemble the gear cover (11) to the bearing housing (1), using the new gasket (9), new rear oil seals (20) and gear cover screw seals (19). Be careful not to damage the lip seal on the drive shaft keyway. Tighten the gear cover screws to the torque shown in Table 1 (3.3 LOCATION & ORIENTATION)
- Ensure the vent plug (12) is at the highest point, the sight glass (13) on the side of the cover and the oil drain outlet at the lowest point and sealed with suitable thread sealant.
- Re-fit the seal housings if removed, rotor case, seals, rotors and end cover as described in section 6. Remember to check the rotor clearances (6.8 ROTOR CLEARANCE - CHECKING & ADJUSTMENT).
- Fill the gearbox with the correct grade and quantity of oil. (3.14 LUBRICATION)
- This should be to the centre of the sight glass (13).
- Some oil may be retained in the sight glass and will give a false impression of the oil level. Be sure that the sight glass is full of oil to its centre.

## 7 ATEX SAFETY MEASURES

Pump type	<div>Risk</div> <div>Liquid</div>	Dry running of mechanical seal (overheated seal faces are an ignition source)	Leakage (inflammable liquid can come into the atmosphere)
Flooded suction Pump	Non ignitable liquid	<ul style="list-style-type: none"><li>Flushed mechanical seal</li></ul>	No danger
	Ignitable liquid		<ul style="list-style-type: none"><li>Flushed mechanical seal</li></ul>

value.

The flashpoint of a combustible liquid is the lowest temperature at which sufficient vapor is created above a combustible liquid so that it can ignite when mixed with air. However, be aware that the temperature of certain spots on the pump (e.g. the mechanical seal or motor) could be warmer than the temperature of the circulated liquid. Therefore, if the flashpoint of the liquid is above the temperature the liquid is pumped but below 135°C, it should also be considered as ignitable when considering the risk leakage.

Please be aware that if a mechanical seal runs dry, the temperature of the seal faces can rise above 400°C.

### Flushed mechanical seal:

You have to make sure there is a continuous circulation of the flushing liquid and the motor is stopped immediately in case of lack of flushing liquid. Otherwise the mechanical seal can run dry and generate dangerous high temperatures. When a quench reservoir is applied, the level of the flushing liquid in the quench reservoir must be guarded by an ATEX approved level sensor. If the level becomes too high or too low, the pump must be stopped. The temperature in the quench reservoir should be guarded by an ATEX approved temperature sensor. The temperature of the flushing liquid should be kept below 60°C. If necessary an external cooling system should be used to keep the flushing temperature under 60°C. It is the responsibility of the end user to use a suitable flushing liquid for the mechanical seals. The mix of the flushing liquid and the pumped liquid must not create any dangerous or explosive gasses.

The pump should never run with closed valve.

### Pumps with Pressure Relief Valve

The purpose of a Pressure Relief Valve is protection of the pump when the discharge pressure rises above the maximum allowable

The PRV's used in Packo LH/HP pumps are not intended to use as by-pass valve!

Due to the rapid temperature increase of the liquid circulating in an open PRV, **it must not be operated open longer than 3 seconds!**

**The baseplate of the pump must be earthed in order to prevent a build-up of static electricity.**

**The pump must not pump liquids warmer than mentioned on the nameplate of the pump.**

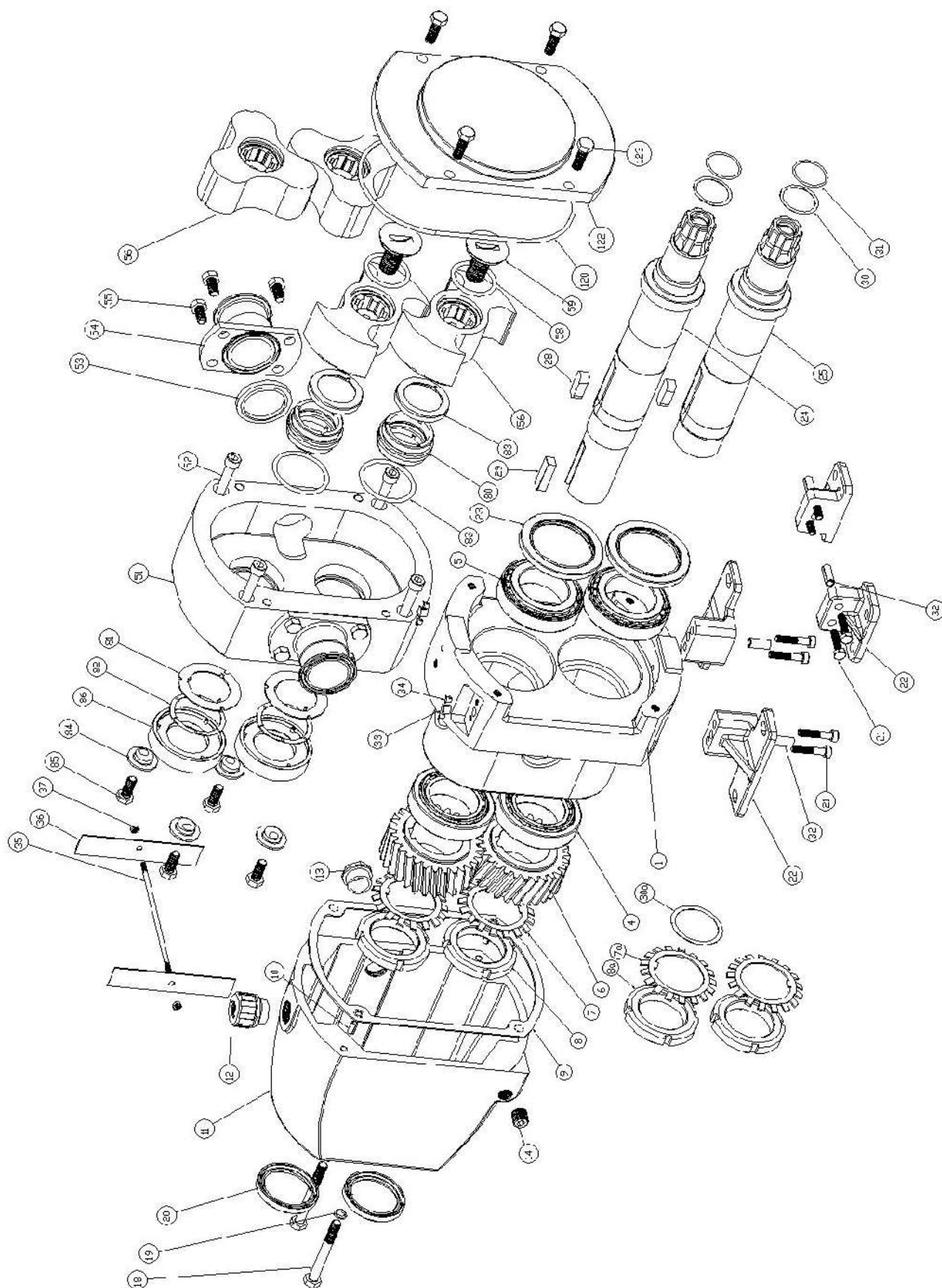
### Flushed mechanical seals are mandatory!

The pump should not be started before compliance with all these safety measures



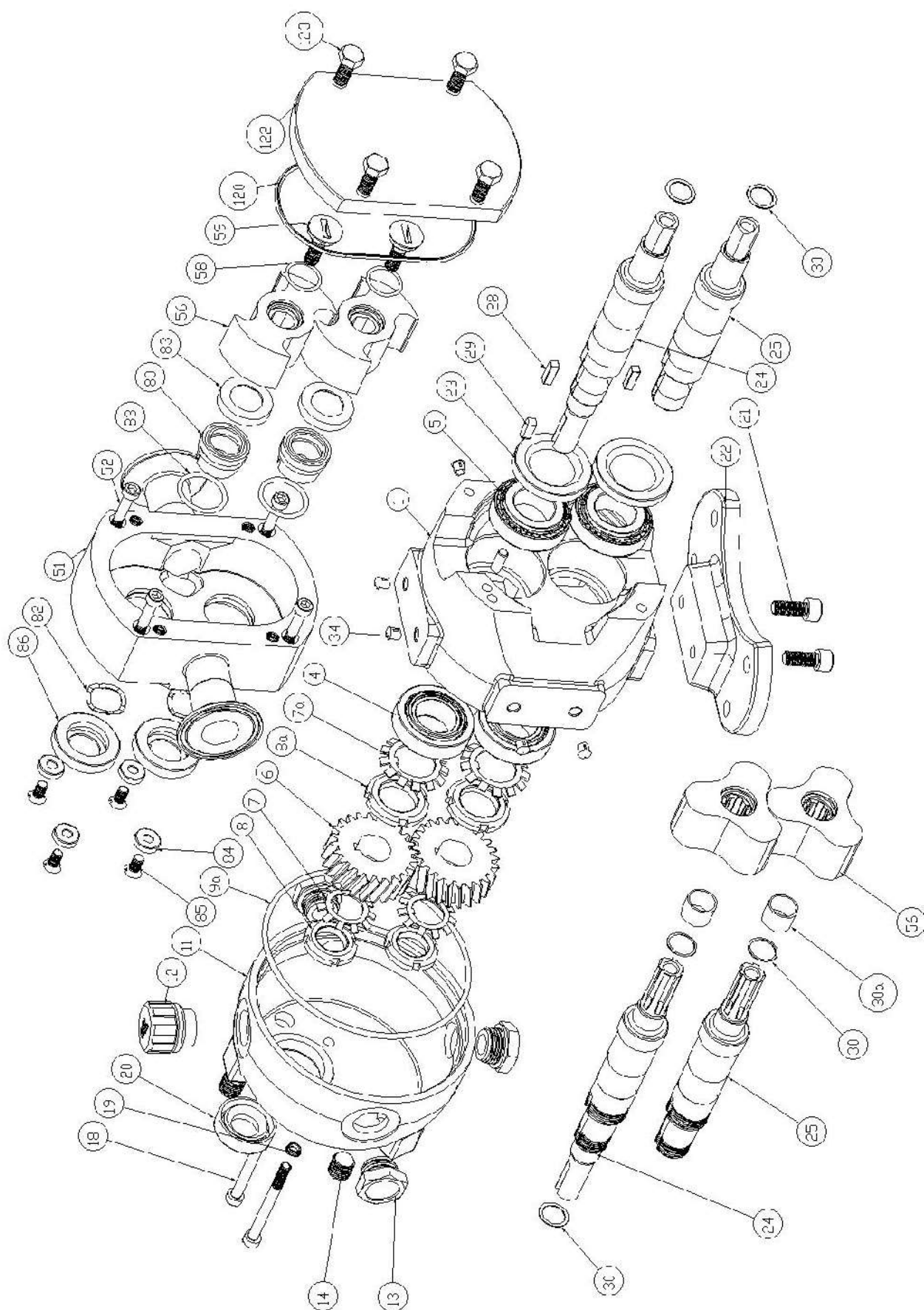
## 8 EXPLODED DIAGRAMS

### 8.1 HP & LH Exploded Diagram



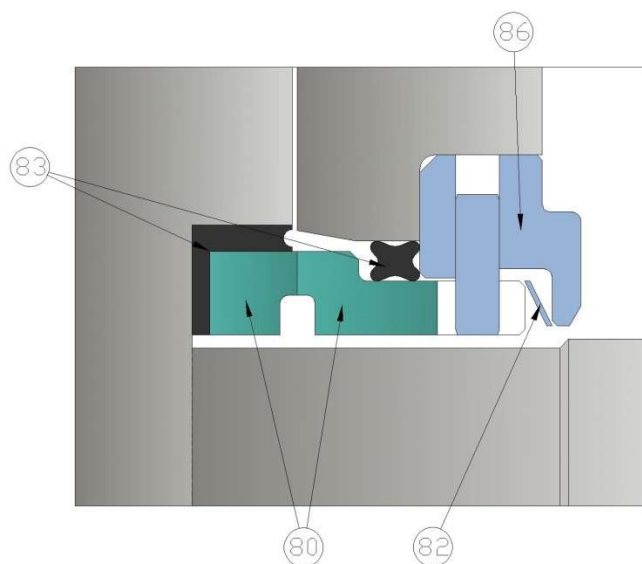
Data sheets highlighting the parts lists are available on request.

## 8.2 HP 3 Size Exploded Diagram

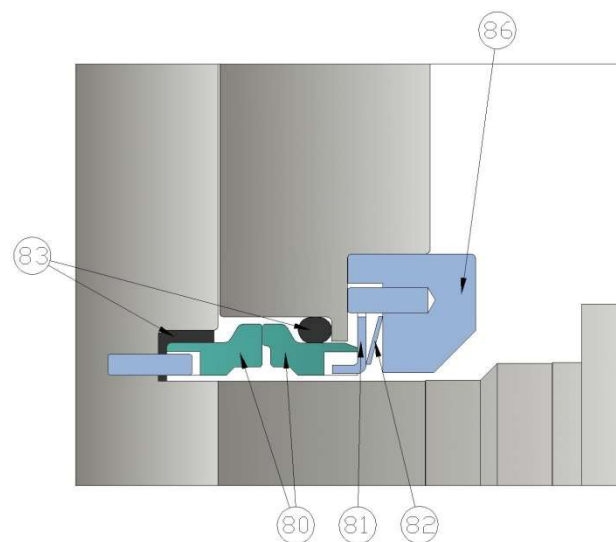


Data sheets highlighting the parts lists are available on request.

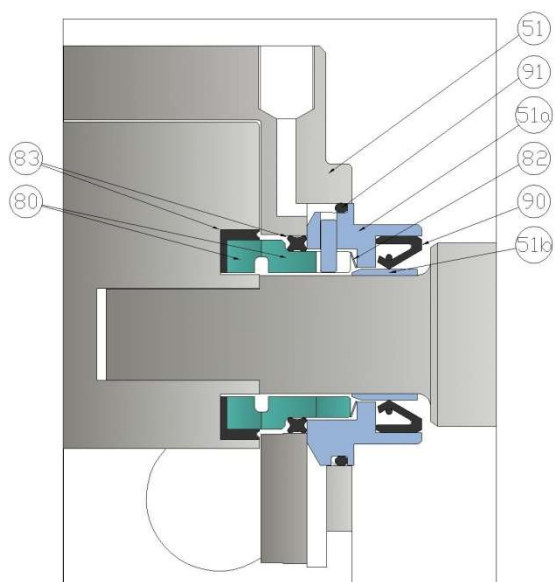
## 8.3 Options & Extras - Sectional Views



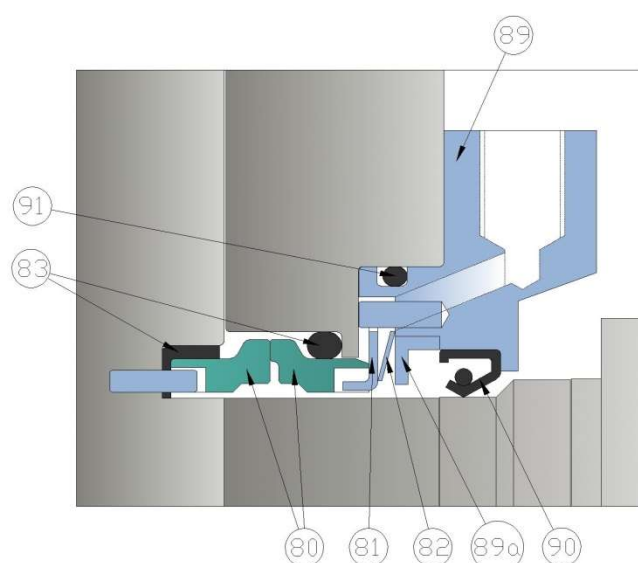
**HP 3 Size Single Mechanical Seal**



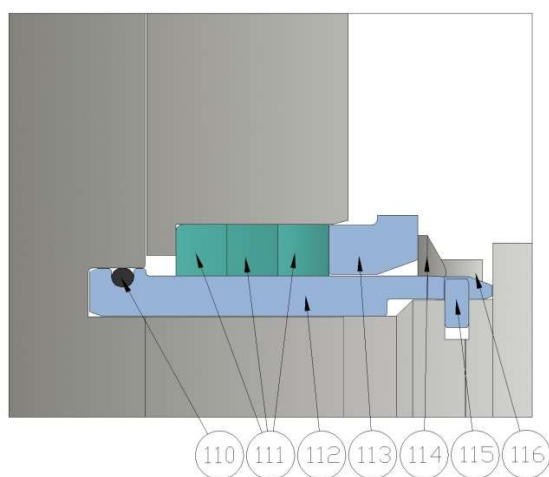
**HP & LH Single Mechanical Seal**



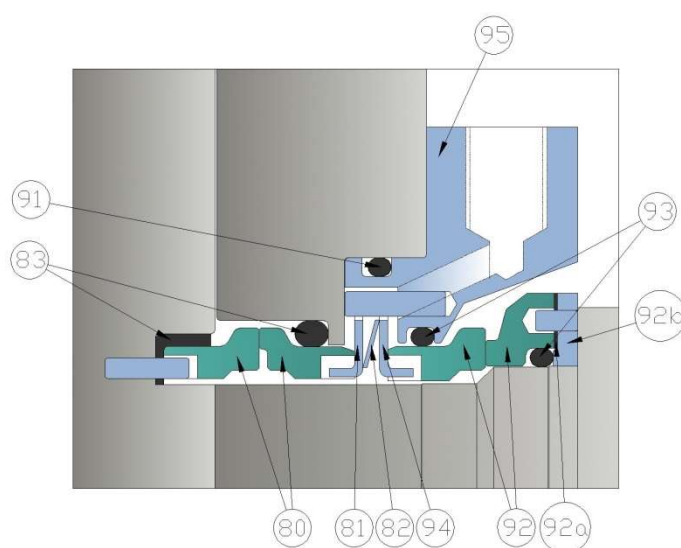
**HP 3 Size Flushed Mechanical Seal**



**HP & LH Flushed Mechanical Seal**

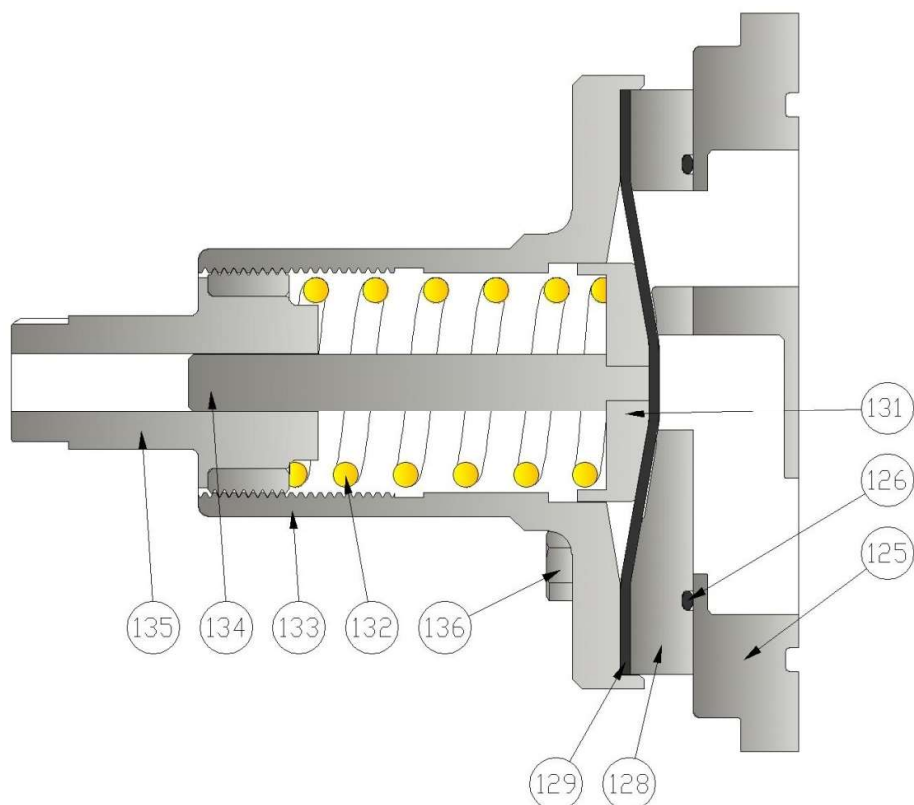


**HP 4 and 5 size Packed Gland Seal**

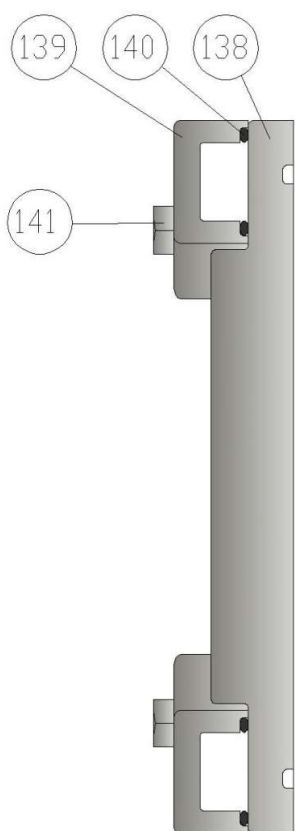


**HP & LH Double Mechanical Seal**

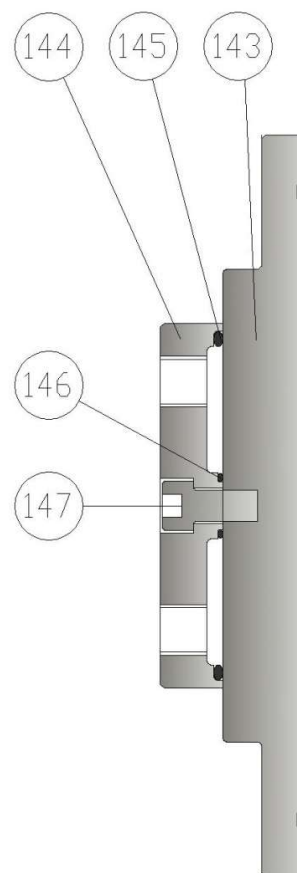




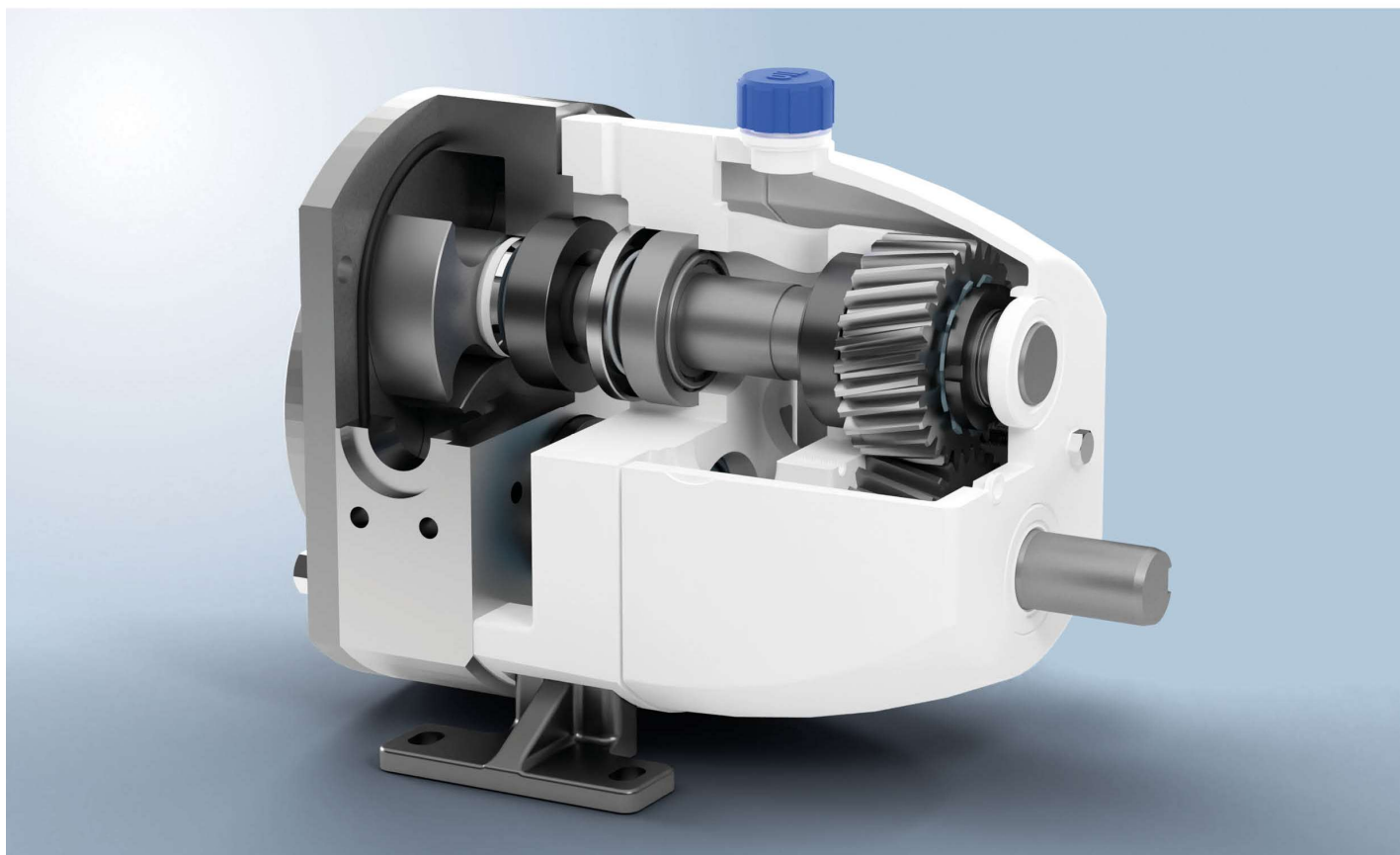
**HP & LH End Cover Relief Valve**



**HP & LH Thermal Jacket – Pump Head**



**HP & LH Thermal Jacket – End Cover**



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