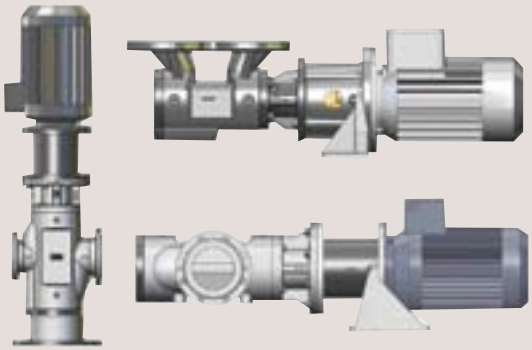
Instruction Manual

Alfa Laval Three-Screw Pumps - 3S Series



ESE02429-EN1 2013-03

Original manual

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The information herein is correct at the time of issue but may be subject to change without prior notice

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1 EC Declaration of conformity

The designated company

Alfa Laval

Company Name

Albuen 31, DK-6000 Kolding, Denmark

Address

+45 79 32 22 00

Phone No.

hereby declare that

Three-Screw Pump	3S	2013-04-01
Denomination	Type	Year

Is in conformity with

- Machinery Directive 2006/42/EC

and futhermore declares that if motorised the following applicable directives have been used
- Directive 2006/95/EC on low voltage
- EMC Directive 2004/108/EC

The technical construction file for this machinery has been drawn up. The signer of this declaration is authorized to compile the technical file.

Manager, Product Center Fluid Handling	Bjarne Søndergaard
Title	Name
Alfa Laval Kolding	
Company	Signature

2 Safety

2.1 Generel information

The operating instructions form part of the pump/pump unit and must be kept for future reference. Furthermore please observe the associated documents. The 3S series with magnetic coupling is described in separate operating instructions.

2.2 Target groups

Target groups	Tasks
Operator - owner	- Keep these instructions available at the system site for future reference. - Ensure that employees read and observe these instructions and the associated documents, in particular the safety instructions and warnings. - Observe additional system - specific directives and regulations.
Specialist personnel, fitters	- Read, observe and follow these instructions and the associated documents, in particular the safety instructions and warnings.

2.3 Symbols

Symbol	Meaning
	Warning personal injury
	Notice
	Procedures mechanical installation
	Procedures electrical installation
	Chek or fault table
▶	Request for action

2.4 Danger levels

Warning	Danger level	Consequences og non-observances	
	DANGER	Immediate threat of danger	Serious personal injury, death
	WARNING	Possible threat of danger	Serious personal injury, invalidity
	CAUTION	Potentially dangerous situation	Slight personal injury
	CAUTION	Potentially dangerous situation	Material damage

2.5 Proper use

- Use the pump solely for transporting lubricating liquids that are chemically neutral and that contain no gas or solid components.
- Use the pump only within the operating limits specified on the name plate and in the Chapter "Technical data". In the case of operating data that does not agree with the specifications on the name plate, please contact the manufacturer.
- The pump is designed specially for the operating pressure named by the customer. If the actual operating pressure deviates notably from this design pressure, damage can also arise within the specified operating limits. This applies both to notably higher as well as to notably lower operating pressures. Under no circumstances should the operating pressure drop below the minimum pressure of 2 bars. In case of any doubt, please contact the manufacturer.

2.6 Safety information

The following general safety instructions must be observed:

- No liability is accepted for damage arising through non-observance of the operating instructions.
  A. Read the operating instructions carefully and observe them.
  B. The operator-owner is responsible for the observance of the operating instructions.
  C. Installation, removal and installation work may only be carried out by specialist personnel.
- In order for the warranty to remain valid, corrective maintenance carried out during the warranty period requires the express permission of the manufacturer.
- Observe the general regulations for the prevention of accidents as well as the local safety and operating instructions.
- Observe the valid national and international standards and specifications of the installation location.
- In case of systems with an increased potential of danger to humans and/or machines the failure of a pump may not lead to injuries or damage to property.
  A. Always equip systems with an increased potential of danger with alarm equipment.
  B. Maintain and check the protective/alarm equipment regularly.
- The pumped liquids can be dangerous (e.g. hot, dangerous to health, poisonous, combustible). Observe the safety regulations for handling dangerous materials.
- Pumped liquids can be subject to high pressure and can cause damage and/or personal injury should leaks occur.

3 Installation

3.1 Unpacking and checking the state of delivery

1. On delivery unpack the pump/pump unit and check for damage during transportation
2. Report damage during transportation immediately to the manufacturer.
3. Dispose of packing material in accordance with the locally applicable regulations.

3.2 Lifting the pump/pump unit

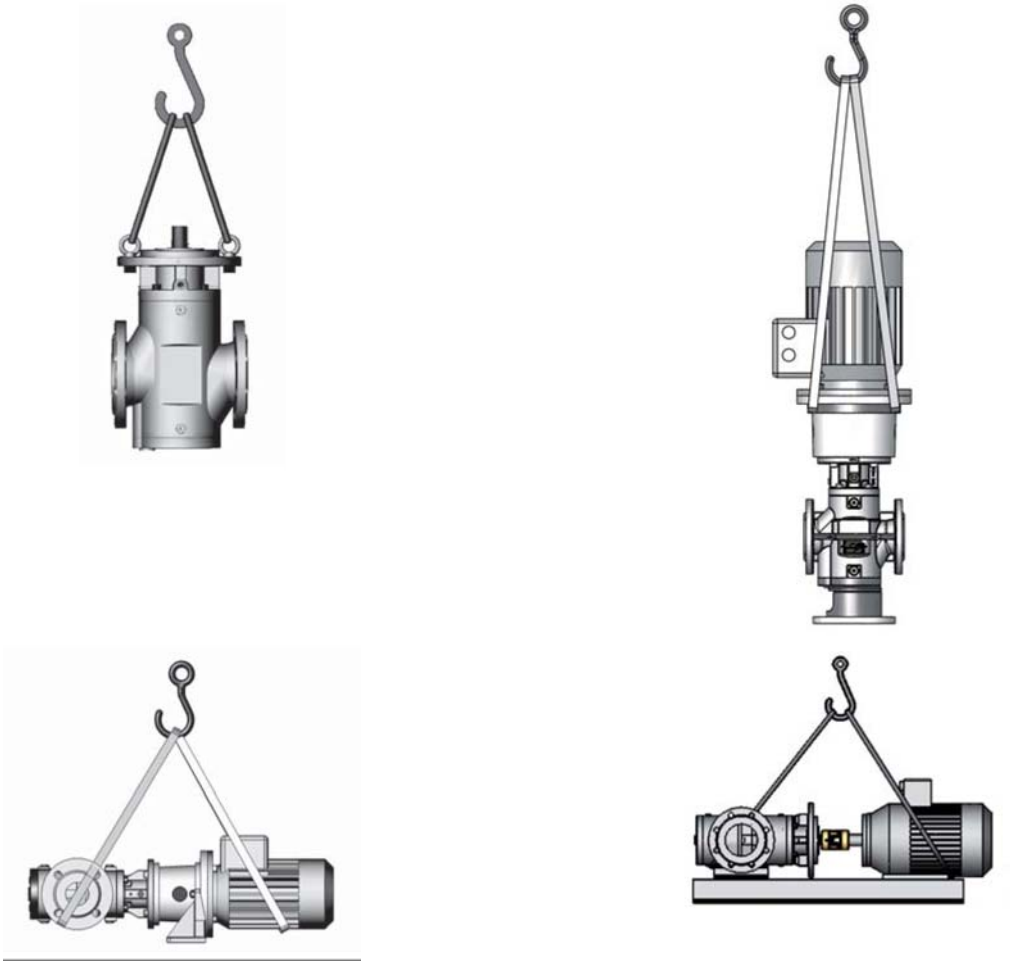


Fig. 1 Fastening hoisting equipment – Principle diagrams

DANGER Risk of injury and/or damage to equipment should the pump/pump unit fall.
▶ Use intact and correctly dimensioned hoisting equipment in accordance with the total weight to be transported.
▶ Select the attachment points for the hoisting equipment in accordance with the center of gravity and the weight distribution.
▶ Use at least two load ropes.
▶ Vertical transport: Secure motor additionally against tilting.
▶ Do not stand under raised loads.

▶ Attach the hoisting equipment to the pump/pump unit, see Fig. 1, page 8, and lift the pump/pump unit.

3.3 Storage

During the test run, the internal components of the pump are wetted with test oil, which has a preservative effect. The pipe connections are fitted with protective caps. Unless otherwise specified, the external components of the pump are preserved with a single-coat PU-based two-component paint. The preservative applied at the factory will protect the pump for about six weeks, if it is stored in a dry and clean location. The manufacturer offers a long-term preservation for storage times of up to 60 months. The pump is additionally packed in hermetically sealing anti-corrosion paper.

3.4 Preservation

Preservation has to be carried out additionally under the following conditions:

Type of delivery	Condition
Standard delivery.	- Storage time exceeding six weeks. - Unfavorable storage conditions such as high humidity, salty air, etc.
Delivery with long-term preservation.	- Opened or damaged packaging.

Tab. 1 - Check table for preservation

Preserving the internal surfaces of the pump

1. Close the suction connection of the pump with a blind flange.
2. Pour non-corrosive, resin-free oil into the pressure connection until it reaches approx. 2 cm under the pressure flange, while slowly turning the main screw against the direction of rotation.
3. Close the pressure connection of the pump with a blind flange.
   After about six months storage check the oil level and if necessary top up oil.

3 Installation

Preserving the external surfaces of the pump

Aids:

- Preservative (e.g. Castrol Rustilo DWX 33)

▶ Paint or spray the preservative onto all plain and unpainted parts.
At intervals of about six months check the preservation and if necessary repeat.

NOTE

Store the preserved pump cool and dry and protect it against direct sunlight.

Removing the preservation

Aids:

- Solvent

- Steam-jet cleaning device with wax-dissolving additives

CAUTION Risk of injury through emitted preservative oil.
▶ Wear protective clothing during all the work. ▶ Open the blind flange carefully in order to reduce any pressure that may exist in the pump. ▶ Collect the emitted preservative oil safely and dispose of it in an environmentally compatible manner.

1. Clean the outside of the pump with solvents, if necessary using a steam-jet cleaning device.
2. Remove the blind flange on the pressure side.
3. Drain the pump, collecting the preservative oil in a suitable vessel.
4. Remove the blind flange on the suction side.
5. To remove the residual oil, rinse the pump with the pumped liquid.

3.5 Disposing of the pump

Aids:

- Solvents or industrial cleaners suitable for the pumped liquid.

WARNING Danger of poisoning and environmental damage from the pumped liquid.
▶ Wear protective clothing during all the work. ▶ Before disposing collect the discharging pumped liquid and dispose of in accordance with the locally applicable regulations. ▶ Before disposing neutralize the residues of the pumped liquid.

1. Disassemble the pump.
2. Clean residues of the pumped liquid from the individual parts.
3. Separate sealing elements made of elastomers and ceramics (SiC) from the pump and dispose of them in the residual waste.
4. Recycle iron parts.

3.6 Installation

Observe the following instructions:
- When selecting the location take the operating limits, NPSH values and ambient conditions into account, see "Technical data". - The function, safety and service life may not be impaired by humidity, temperature influences or explosive atmospheres. - During the installation ensure that all the parts can be accessed easily and that the maintenance work can be carried out easily.

Installing the pump

Screw pumps can be operated in any installation position. However, the manufacturer recommends that the pump not be mounted above the motor since pumped liquid can ingress the motor if a leak occurs.

Prerequisite:

- The pump connections are to be protected against contamination, for example by using the protective cover mounted in the factory.

CAUTION Leaking pumped liquid can damage the motor.
▶ Do not mount the pump above the motor.

CAUTION Damage to the pump and piping through insufficient fastening.
▶ Only fasten the pump on a stable bearing underground. ▶ Ensure that the fastening elements are fastened sufficiently.

3 Installation

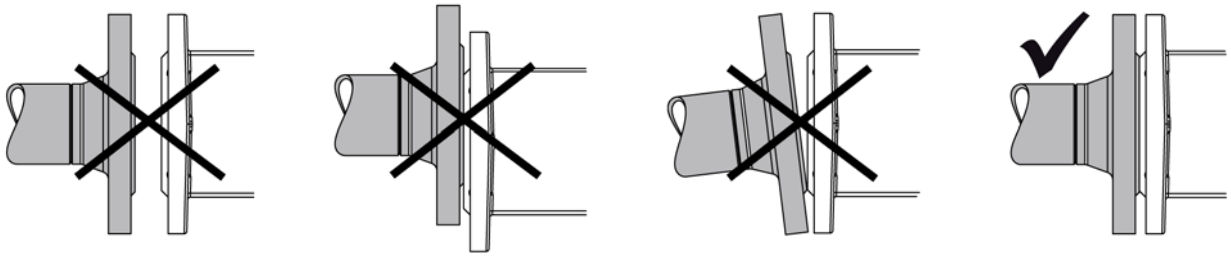
1. Place the pump in position, while ensuring that the flow direction that is marked by arrows on the flanges is correct, see Fig. 2, page 19.
2. Fasten the pump with fastening elements securely on the underground.

Protect the pump against contamination

CAUTION Damage through impurities in the pipe system.
▶ During welding work attach protective covers in front of the connecting flanges. ▶ Ensure when welding that welding beads and abrasive dust cannot get into the pipe system and the pump.

▶ After the connecting work clean the pipe system thoroughly, see "Cleaning the pipe system", page 18.

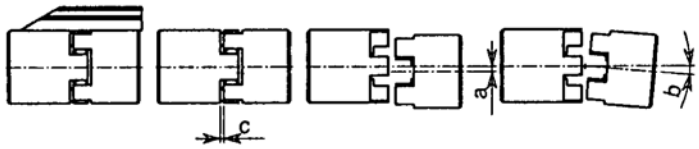
Connecting the pump to the pipe system



CAUTION Danger of damage to the device or impaired functionality through mechanical stresses.
▶ Ensure that the pump mounting on the pipe system is free of mechanical stress.

1. Turn the pump shaft or fan impeller of the motor so that smooth running of the pump is checked. If the pump cannot be turned by hand, remedy the fault before installing the pump, see "Troubleshooting".
2. During welding work attach protective covers in front of the connecting flanges.
3. Place the piping in position and support the weight of the piping.
4. Check the linear, lateral and angular offset and correct if necessary.
   If the screws tighten easily, this is a sure sign that the installation is stress-free.
5. Tighten the connecting screws in an alternating fashion with torque, see Tab. 9, page 45.

Assembling the pump and motor



a Lateral offset
b Angular offset
c Linear offset

Fig. 2 Measuring points for tolerances of the coupling alignment

Coupling diameter [mm]	Lateral offset a max.[mm]	Angular offset b max.[°]	Linear offset c min.[mm]	max.[mm]
40	0.2	0.9	2.0	3.0
55	0.2	0.9	2.0	3.5
65	0.25	0.9	2.5	4.0
80	0.3	1.0	3.0	4.5
95	0.3	1.0	3.0	5.0
120	0.4	1.1	4.0	6.0
135	0.4	1.2	4.5	7.0
160	0.5	1.2	5.0	8.0

Tab. 2 Limit values for aligning the shaft coupling

CAUTION Incorrect alignment of the shaft coupling causes noise, vibration and damage to the coupling and bearing.
▶ After the mounting check the alignment of the coupling.

1. Check the linear offset of the coupling using a slide gauge or feeler gauge.
   If the limit values of the above table are exceeded, loosen the fastening of the pump or motor and move the device in order to adjust the linear offset.
2. Check the lateral offset of the coupling using a hairline gauge and feeler gauge. Check several points along the periphery of the coupling.
   If the limit values of the above table are exceeded, loosen the fastening of the pump or motor and move the device in order to reduce the lateral offset.
3. Check the angular offset of the coupling using a hairline gauge.
   If the limit values of the above table are exceeded, loosen the fastening of the pump or motor and move the device in order to reduce the angular offset.

3.7 Connecting the motor

WARNING Risk of death resulting from electric shock.
▶ The motor may only be connected by anauthorized electrician.
▶ Ensure that the power supply is de-energized.
▶ Ground the pump carefully.

1. Observe the operating instructions of the motor.
2. Ensure that the operating data on the rating plate of the motor agree with the operating data of the pump and with the local power supply.
3. Connect the motor in the motor terminal block in accordance with the circuit diagram.

3.8 Removing the pump

Aids:

- Vessel to collect pumped liquid.

DANGER Risk of death resulting from electric shock.
▶ Ensure that the power supply is de-energized. ▶ The motor may only be separated from the power supply by anauthorized electrician.

WARNING Risk of injury through emitted hot, poisonous or corrosive pumped liquid.
▶ Wear protective clothing during all the work. ▶ Before beginning work, let the pump cool down to the ambient temperature. ▶ Ensure that the pump is depressurized. ▶ Collect the pumped liquid safely and dispose of it in an environmentally compatible manner.

1. Disconnect the motor from the power supply and secure it against being switched back on.
2. Close the pressure-side and suction-side shut-off devices.
3. Empty the pump at the lower point using the draining plug. Collect the emitted pumped liquid in a suitable vessel.
4. Loosen the connecting flange.
5. Loosen the fastening of the pump unit on the foundation and dismantle the motor and pump bracket.

3.9 Heating system

The pumps can be equipped optionally with heating systems. The manufacturer recommends heating systems for high-viscosity liquids that do not flow sufficiently if not heated. This can result in excessive power consumption or to problems arising through cavitation or sealing.

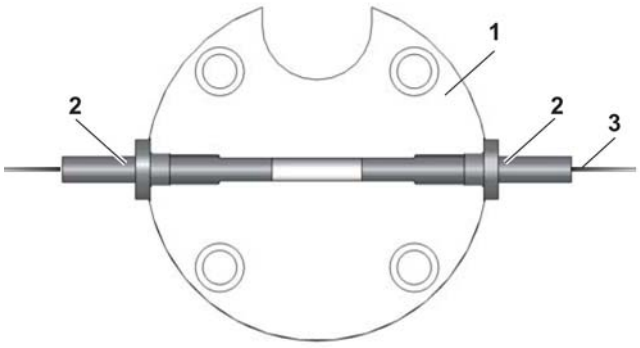
Method of heating:

- Electric heating system

- Fluid heating system

- Heating system special design

3.10 Electric heating system



1. Heating cover
2. Heating element
3. Connecting cable

Fig. 3 Electric heating system

The electric heating system consists of one or two heating elements 2 that are integratedin a heating cover 1 attached additionally to the end cover. The output of the cartridges corresponds to the radiation and convection losses of the pump in the required temperature range so that overheating is not possible.

Operating data:

- Voltage: 230 V

- Frequency: 50/60 Hz

- Wire cross-section: 2 x 1 mm²

Mounting the electric heating system
Scope of delivery:

Sizes 3S 5 – 118	Sizes 3S 160 – 2900
- 1 heating element - 1 heating cover - 4 socket screws	- 2 heating elements - 1 heating cover - 4 socket screws

Pay attention to the following when installing the heating element:
- Protect the area of the connecting head against liquid and pasty liquids (lubricants, oil, plastics, etc.) as well as their vapors, because leakage currents or flashovers otherwise occur at the emersion point of the supply line. - Protect the supply lines against mechanical vibrations in the area of the emersion from the heating element. Any vapors arising have to escape freely. - Store the heating element in an absolutely dry room or in hermetically sealed plastic bags. If the heating element has absorbed humidity, dry it for 8 hours in a drying furnace at 180°C.

1. Remove the socket screws and rating plate at the end cover of the pump.
2. Mount the heating cover to the end cover using the supplied socket screws.
3. Screw the heating element into the heating cover.
4. Mount the rating plate on the heating cover.

Connect and commission the electric heating system
Required heating-up period for temperature differences of 30°C or 50°C:

Size	Power consumption [W]	Heating-up period [min] at a temperature difference of 30°C	50°C
3S 5 – 42	1 x 100	20	35
3S 55 – 118	1 x 220	20	35
3S 160 – 275	2 x 180	25	45
3S 370 – 450	2 x 180	30	60
3S 550 – 660	2 x 250	45	75
3S 851 – 1301	2 x 250	60	90
3S 1500 – 1700	2 x 250	75	120
3S 2200 – 2900	2 x 250	90	150

Tab. 3 Heating-up period for electric heating system

DANGER
Risk of death resulting from electric shock.

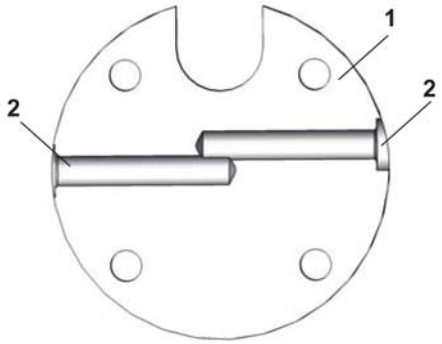
- ▶ The electric heating system may only be connected by anauthorized electrician.
- ▶ Ensure that the power supply is de-energized during the connecting work.

WARNING
Danger of the pump housing bursting and danger of injury through emitted pumped liquid through the heat expansion of the pumped liquid.

- ▶ Open all the valves during the heating process.

1. Connect the connecting cable of the heating element.
2. Switch on the electric heating system.

3.11 Fluid heating system



1 Heating cover
2 Pipe connections

Fig. 4 Fluid heating system

The fluid heating system consists of a heating cover **1** attached additionally to the end cover through which a heating liquid (e.g. vapor, thermal oil) flows.

Operating data:

- Maximum pressure: 16 bar

- Maximum liquid temperature: 200°C

Mounting the fluid heating system

Scope of delivery:

Sizes 3S 5 – 2900
- 1 heating cover - 4 socket screws

1. Remove the socket screws and rating plate at the end cover of the pump.
2. Mount the heating cover to the end cover using the supplied socket screws.
3. Mount the piping.
4. Mount the rating plate on the heating cover.

Commissioning the fluid heating system

Required heating-up period for the temperature difference of 50°C at a liquid temperature of 200°C:

Size	Heating-up period [min] at a temperature difference of 50°C
3S 5 – 118	20
3S 160 – 275	45
3S 370 – 450	60
3S 550 – 660	90
3S 851 – 1301	120
3S 1500 – 1700	150
3S 2200 – 2900	180

Tab. 4 Heating-up period for fluid heating system

WARNING Danger of the pump housing bursting and danger of injury through emitted pumped liquid through the heat expansion of the pumped liquid.
▶ Open all the valves during the heating process.

▶ Observe the permissible operating limits of the pump when setting the supplied mass flow and its temperature, see Tab. 3, page 38.

3.12 Heating system special design

Please contact the manufacturer for special designs.

4 Operation

4.1 Commissioning

Be sure to observe the following instructions:
▶ The pump may only be commissioned by authorized qualified personnel.
▶ Wear protective clothing during all the work.

Cleaning the pipe system

Clean the complete pipe system before commissioning in order to protect the pump. If this is to be realized by rinsing using the pump, an additional commissioning filter has to be installed before the pump.

Mesh width of the commissioning filter:

- 0.02 mm

CAUTION Damage to the device through additional pressure loss in the commissioning filter
▶ Calculate the flow resistance and determine the remaining pump intake.
▶ Monitor the suction-side pressure.
▶ Check and clean the commissioning filter regularly.

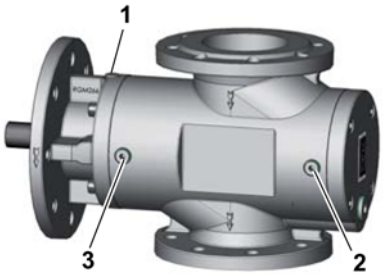
▶ Recommended rinsing duration with commissioning filter: 50 – 100 hours.

Filling the pump

There are two possible ways to fill the pump:

- via the suction or pressure connection

- via the vent holes



1. Vent hole of the seal
2. Suction-side vent hole
3. Pressure-side vent hole

Fig. 1 Vent holes

Filling the pump via the suction or pressure connection

WARNING Danger of injury or poisening through dangerous pumped liquids.
▶ Collect the emitted pumped liquid safely and dispose of it in an environmentally compatible manner.

1. Open the vent hole **1** so that the air can escape during the filling process.
2. Open the suction- or pressure-side shut-off device and fill the pump via the suction or pressure connection until pumped liquid is emitted at the vent hole of the seal.
3. During the filling process turn the pump shaft or the fan impeller of the motor by hand to speed up the filling process:
   Filling via suction connection: Turn the pump shaft in the direction of rotation of the motor.
   Filling via pressure connection: Turn the pump shaft against the direction of rotation of the motor.
4. Close the vent hole **1**.

Filling the pump via the vent hole

WARNING Danger of injury or poisoning through dangerous pumped liquids
▶ Collect the emitted pumped liquid safely and dispose of it in an environmentally compatible manner.

1. Open the vent hole 1 so that the air can escape during the filling process.
2. Fill the pump via the pressure-side vent hole **3**.
3. During the filling process turn the pump shaft or the fan impeller of the motor by hand against the direction of rotation of the motor in order to speed up the filling process.
4. Close the pressure-side vent hole **3**.
5. Fill the sealing space of the pump via the vent hole **1** until the pumped liquid is emitted.
6. Close the vent hole **1**.

Checking the direction of rotation

The direction of rotation and the flow direction are indicated by arrows on the pump. The direction of rotation of the motor gives the direction of rotation of the pump. That is to say, the fan impeller of the motor must rotate in the direction in which the arrow on the pumpis pointing to indicate direction of rotation.

- Standard direction of rotation: clockwise (viewed from the drive)

1. Leakage discharge
2. Rotation-direction arrow
3. Arrow for flow direction

Fig. 2 Identifying direction of rotation and flow direction

CAUTION Dry running can damage pump equipment
▶ Ensure that the pump is filled properly.
▶ Switch the pump on for a maximum of 1 second and then off again immediately.

4 Operation

1. Switch on the power supply and then turn it off again immediately.
2. Compare the direction of rotation of the fan impeller with the arrow indicating direction of rotation on the pump flange.
3. If the directions do not match, swap over two electrical connection phases. Repeat steps 1 and 2.

Commissioning the pump

Prerequisites:

- Pump set up and mounted correctly
- Motor connected correctly
- Pipe system is free of contamination
- Pump is filled
- Shut-off devices in the suction and pressure line opened

WARNING Danger of injury through rotation is mounted.
▶ Ensure that the coupling protection is mounted.

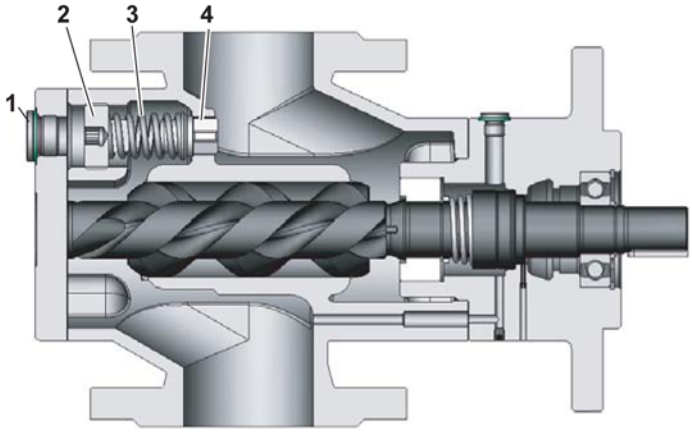
WARNING Risk of injury through emitted pumped liquid
▶ Wear protective clothing during all the work. ▶ Ensure that all the connections are connected sealingly.

CAUTION Dry running can damage pump equipment
▶ Ensure that the pump is filled properly. ▶ If the pump does not deliver after 10–15 seconds, abort commissioning.

1. Switch on the pump.
   The pump will deliver when the pressure on the pressure side of the pump rises or a system-side flow indicator triggers.
2. If the pump does not deliver after 10–15 seconds of operation, abort commissioning, establish the cause of the fault and only then continue the commissioning procedure. Follow the instructions in the fault table, see "Troubleshooting".
3. Run the pump for a few minutes to allow the pipe system to vent fully.
   The pipe system is fully vented when there is a smooth operating noise and a pressure gauge on the pressure side of the pump shows no more fluctuations.

4.2 During operation

Adjusting the overflow valve



1. Screw plug
2. Adjusting screw
3. Spring
4. Valve body

Fig. 3 Overflow valve mounting position

Factory setting:

- 110 % of the nominal pressure

Aids:

- Pressure-side pressure gauge

- Allen key

Size	ISO 228-1	Hexagon socket
5 - 20	G 1/4"	Size 6
32 - 42	G 1/4"	Size 8
55 - 118	G 1/4"	Size 17
160 - 275	G 1/4"	Size 10
370 - 450	G 1/4"	Size 17
550 - 660	G 1/4"	Size 10
851 - 2900	G 1/4"	Size 17

Tab. 1 Allen key widths

WARNING Risk of injury or poisoning through emitted pumped liquid
▶ Wear protective clothing during all the work. ▶ Collect the emitted pumped liquid safely and dispose of it in an environmentally compatible manner.

1. Switch on the pump and open the screw plug **1** of the overflow valve.
2. Increase the delivery pressure step-by-step to check the opening pressure of the valve. Keep an eye on the pressure gauge and make sure that he pressure stays within the operating limits.
   When the overflow valve opening pressure is reached, the displayed pressure drops.
3. Turn the adjusting screw **2** to adjust the opening pressure:
   Turning clockwise: In crease the opening pressure
   Turning anticlockwise: Decrease the opening pressure.
4. Repeat steps 3 and 4 until the desired opening pressure is reached.
5. Retighten the screw plug.

Switch off the pump

CAUTION Damage to seals through pressurizing of the pump while it is standing still.
▶ Ensure that while the pump is at a standstill, the pressure in the pump does not exceed the inlet pressure during operation.

1. Switch off the motor.
2. Close the pressure-side and suction-side shut-off devices.

4.3 Taking the pump out of operation

WARNING Risk of In jury or poisoning through emitted pumped liquid.
▶ Wear protective clothing during all the work.
▶ Collect the emitted pumped liquid safely and dispose of it in an environmentally compatible manner.

▶ Carry out the following measures during shutdowns:

Pump is	Measure
- Shut down for longer period	▶ Measures depend on pumped liquid, see Tab. 3, page 32.
- Drained	▶ Close the pressure-side and suction-side shut-off devices.
- Dismantled	▶ Disconnect the motor from the power supply and secure it against being switched back on.
- Stored	▶ Observe measures for storing and preservation, see "Storage", page 9 and see "Preservation", page 9.

Tab. 2 Measures for operation interruption

Behavior of the pumped liquid	Duration of the operation interruption	
	Short	Long
- Sediment solids	▶ Rinse the pump.	▶ Rinse the pump.
- Congealed/frozen - No corrosive burden	▶ Heat or drain the pump.	▶ Drain the pump.
- Congealed/frozen - Corrosive burden	▶ Heat or drain the pump.	▶ Drain the pump. ▶ Preserve the pump.
- Remains liquid - No corrosive burden	-	-
- Remains liquid - Corrosive burden	-	▶ Drain the pump. ▶ Preserve the pump.

Tab. 3 Measures depend on behavior of the pumped liquid

▶ Drain the pump via the pressure and suction line and vent screws and screw plugs.

4.4 Recommissioning the pump

▶ Carry out all the steps as for the commissioning process, see "Commissioning", page 18.

5 Maintenance

5.1 Safety instructions

Observe the following safety instructions at all the work:
▶ All the work may only be carried out by authorized qualified personnel.
▶ Wear protective clothing during all the work.
▶ Switch off the motor and secure it against being switched back on.
▶ Before beginning work, let the pump/pump unit cool down to the ambient temperature.
▶ Ensure that the pump is depressurized.
▶ Collect the emitted pumped liquid safely and dispose of it in an environmentally compatible manner.

5.2 Required maintenance

The service life of the pump depends to a great extent on the operating conditions. If the operating limits are observed, see Tab. 2, page 38, the pump has a service life of many years.
Signs of progressive wear of individual pump elements:

Finding	Cause	Elimination
Increased running noises	Incipient damage to bearing	Replace the bearing.
Increased leaking	Incipient damage to seal	Replace the shaft seal.
Deposits on the seal	Low-volatile liquids	Clean the seal.
Increased play in the shaft coupling	Advanced wear of the coupling intermediate ring	Replace the coupling intermediate ring
Reduction in the flow rate or pressure under constant operating conditions	Advanced wear of screws and housing	Replace the pump.

Tab. 1 Check table for required maintenance

1. Check the pump visually and acoustically every four weeks.
2. Check for signs of wear as listed in the table above and eliminate the cause.

Mechanical seal

Mechanical seals are subject to a natural wear that depends strongly on the respective conditions of use. General statements about the durability can therefore not be given.
In case of heavy pollution with solidified and/or sticky leakage residues the manufacturer recommends that you dismantle the mechanical seal completely and carefully wash it, together with the inner surfaces of the flange cover.

Ball bearing

The ball bearings used are lifetime lubricated. Maintenance is therefore not required. The manufacturer recommends renewing the ball bearings every 20,000 operating hours.

Cleaning leakage ventholes

The regular small amounts of leakage can result in deposits that can prevent free draining of further leakage liquids after a longer operating period. The leakage vent holes must therefore be checked every four weeks and if necessary cleaned.

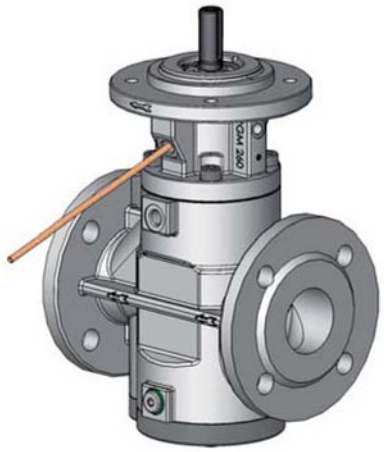


Fig. 1

CAUTION Bearing damage due to insufficient drainage of shaft seal leakage
▶ Check permeability of leakage vent holes regularly.

1 Screw off any lekage line that is connected.
2 Check the permeability of the lekage line:
Observe whether a small amount of added liquid drains.
- or -
▶ Check visually
- or -
▶ Insert an arbor made of a soft material (wood, plastic, etc.), see Fig. 1.
3 Clean the line or leakage vent hole, if it is not free.
4 Reconnect any lekage line that is connected.

5 Maintenance

5.3 Replacing the coupling

Removing the coupling

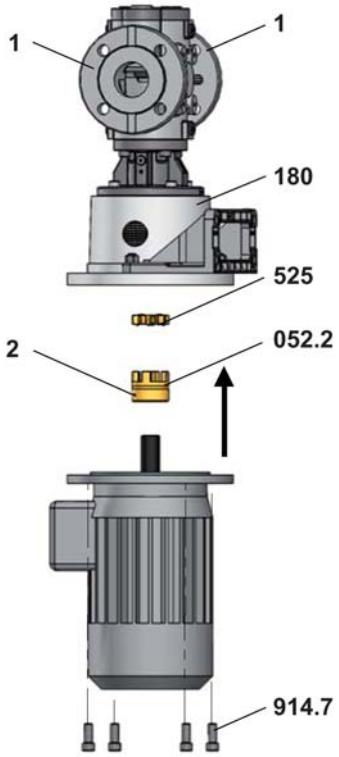


Fig. 2

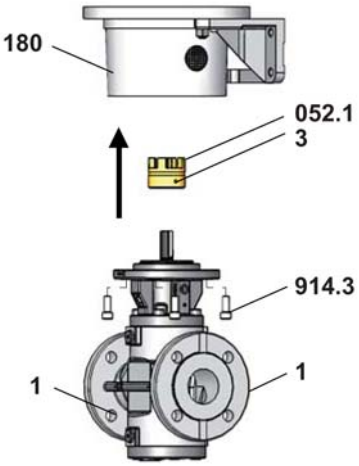


Fig. 3

1	Suction/pressure connection
2	Fixation screw
3	Fixation screw
052.1	Pump-side coupling half
052.2	Motor-side coupling half
180	Pump bracket
525	Coupling intermediate ring
914.3	Socket screw
914.7	Socket screw

WARNING Risk of injury and/or damage to equipment should the pump/pump unit fall.
▶ Lift the large pump using the crane. ▶ Do not stand under raised loads.

1. Before dismantling close the suction and pressure connection 1 of the pump with covers.
2. Loosen the connecting screws 914.7 between the motor and pump bracket 180 and lift the pump with pump bracket from the motor, see Fig. 2, page 35.
3. Loosen the fixing screw 2 on the motor-side coupling half 052.2.
4. Remove the coupling intermediatering 525 and pull off the coupling half 052.2 using a suitable tool.
5. Loosen the connecting screws 914.3 between the pump and pump bracket 180 and remove the pump bracket, see Fig. 3, page 35.
6. Loosen the fixing screw 3 on the pump-side coupling half 052.1 and pull off the coupling half using a suitable tool.

Installing the coupling

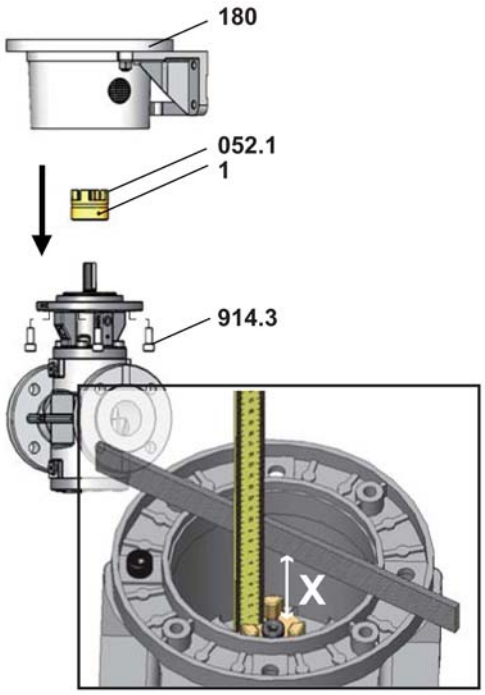


Fig. 4

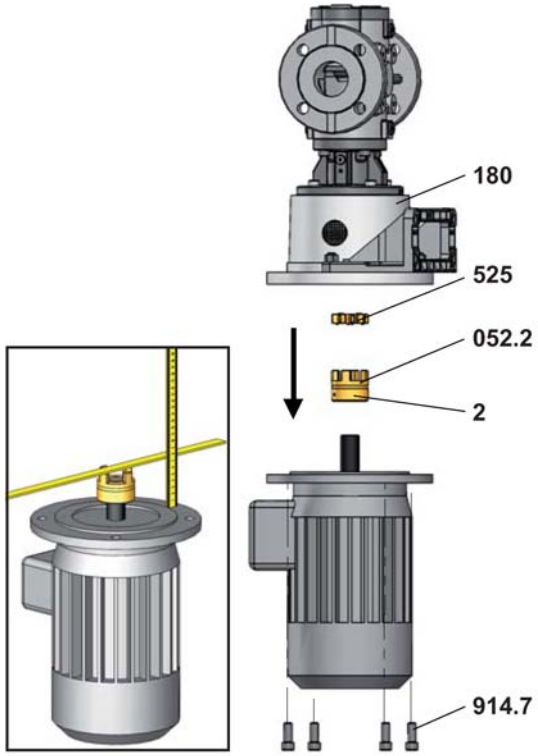


Fig. 5

1	Fixation screw	180	Pump bracket
2	Fixation screw	525	Coupling intermediate ring
052.1	Pump-side coupling half	914.3	Socket screw
052.2	Motor-side coupling half	914.7	Socket screw

Aids:

- Measuring stick

1. Grease the shaft lightly.
2. Slide the pump-side coupling half 052.1 onto the shaft until it stops. Heating the coupling to 80°C – 100°C facilitates mounting. Tighten the fixing screw 1 of the coupling half.
3. Place the pump bracket 180 on the pump and tighten the connecting screws 914.3.
4. Measure and write down the distance X between the face of the coupling and the connecting surface of the pump bracket, see Fig. 4.
5. Mount the motor-side coupling half 052.2 on the shaft end of the motor, see Fig. 5. Heating the coupling to 80°C – 100°C facilitates mounting.
6. Check the distance between the face of the coupling teeth and the connecting surface of motor flange. The distance has to be adjusted to the value X - c, see Tab. 2, page 13.
7. Tighten the fixation screw 2 at the coupling half 052.2 and insert the coupling intermediate ring 525.
8. Place the pump with the pump bracket on the motor.
9. Turn the pumps lightly until the teeth of the pump-side coupling half 052.1 meshes correctly into the spaces of the coupling intermediate ring 525.
10. Tighten the connecting screws 914.7 between the motor and pump bracket with torque, see Tab. 9, page 45.

5 Maintenance

5.4 Replacing the mechanical seal

Removing the mechanical seal

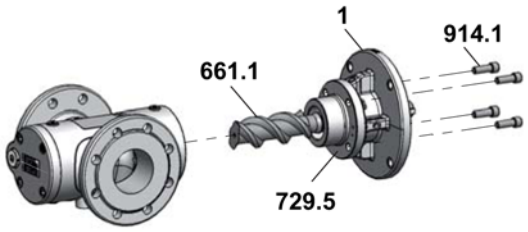


Fig 6

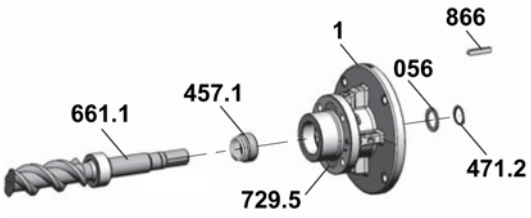


Fig 7

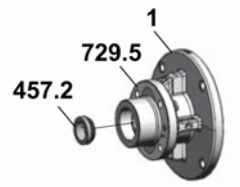


Fig 8

1	Flange cover	457.2	Stationary seal ring
2	Threaded pin	471.2	Circlip
056	Supporting ring	661.1	Main screw
457.1	Rotary seal ring	729.5	Flat gasket
		866	Feather key

Aids:

- Plastic hammer

1. Remove the socket screws 914.1 and loosen the flange cover 1 using light" rebound" blows.
2. Pull the withdrawable unit consisting of main screw 661.1, bearing, seal and flange cover out of the pump housing, see Fig.6.
3. Remove the feather key 866.
   3S32 – 1700: Remove the circlip 471.2 and the supporting ring 056.
   3S2200 – 2900: Remove the threaded ring 057 (without illustration).
4. Drive the mains crew out of the flange cover with light blows from a plastic hammer.
5. Mechanical seal of hardmaterial: Loosen the threaded pins 2. Remove the rotary seal ring 457.1 and corresponding parts of the mechanical seal from the mainscrew, see Fig. 7.
6. Press the stationary seal ring 457.2 together with the mounted O-ring out of the flange cover 1, see Fig. 8.
7. Remove the residues of the flat gasket 729.5 from the flange cover and pump housing.

Installing the mechanical seal

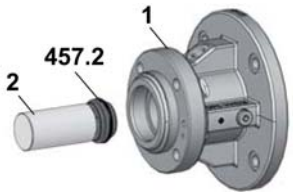


Fig 9

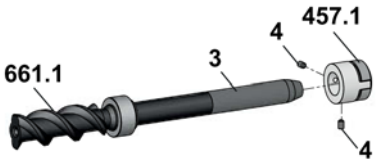


Fig 10

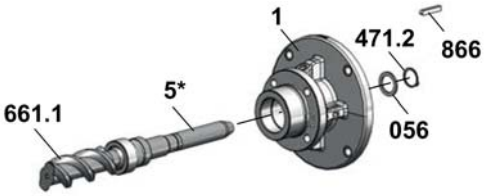


Fig. 11

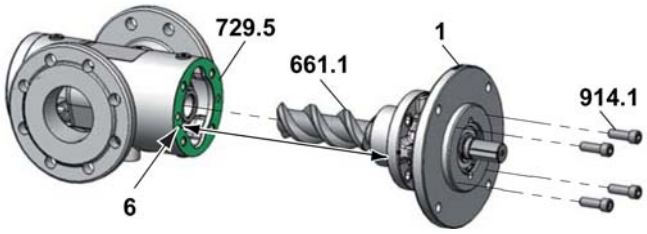


Fig 12

1	Flange cover	457.1	Rotary seal ring
2	Mounting arbor stationary seal ring	457.2	Stationary seal ring
3	Mounting sleeve main screw	471.2	Circlip
4	Threaded pin	661.1	Main screw
5*	Mounting sleeve flange cover	729.5	Flat gasket
6	Straight pin	866	Feather key
056	Supporting ring	914.1	Socket screw

* Only for 3S 851 - 2900

Aids:

- Tool set mechanical seal

1. Clean the fitting surfaces, grease the O-rings lightly.
2. Use stationary seal ring mounting arbor **2** to press the stationary seal ring **457.2** with the mounted O-ring into the flange cover **1**. Take the position of the clearance for the dowel pin (anti-rotation) into account, see Fig.9.
3. Clean the main screw **661.1** around the mechanical seal carefully and grease it.
4. Slide the rotary seal ring **457.1** and the corresponding parts of the mechanical seal spring onto the main screw. Use the main screw mounting sleeve **3** to this purpose, see Fig. 10. Tighten the threaded pins **4**.
5. Remove the mounting sleeve, clean the slide surfaces of the mechanical seal and grease with silicone grease.
6. Slide the main screw with mounted rotary seal ring into the flange cover, see Fig. 11.
   Notice: As of size K 851 use the flange cover mounting sleeve **5*** to this purpose.
7. 3S 32 –1700: Mount the supporting ring **056** and circlip **471.2**.
   3S 2200 – 2900: Mount the threaded ring **057** (without illustration).
   Mount the feather key **866**, see Fig. 11.
8. Bond the new flatgasket **729.5** on the pump housing.
9. Slide the main screw with premounted flange cover into the pump housing until the main screw engages into the idle screws. Take the position of the straight pin **6** into account and turn the main screw, see Fig. 12.
10. Tighten the socket screws **914.1** with torque, see Tab. 9, page 45.

5.5 Replacing the ball bearing

Removing the ball bearing

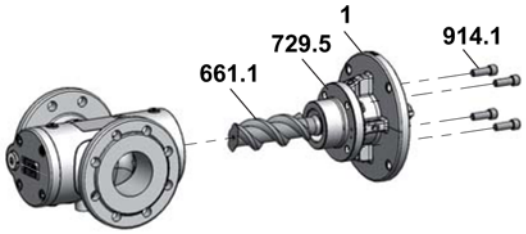


Fig 13

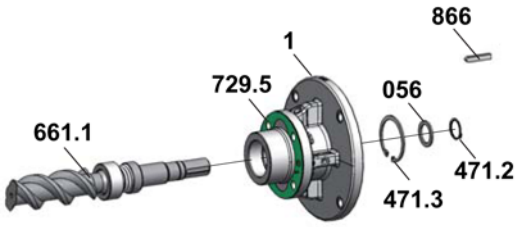


Fig 14

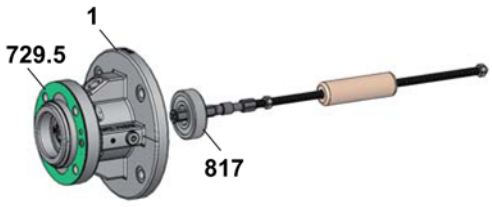


Fig. 15

1	Flange cover
056	Supporting ring
471.2	Circlip
471.3	Circlip

661.1	Main screw
729.5	Flat gasket
817	Ball bearing
866	Feather key
914.1	Socket screw

Aids:

- Plastic hammer

- Extractor

1. Remove the socket screws 914.1 and loosen the flange cover 1 using light "rebound" blows.
2. Pull the with drawable unit consisting of main screw 661.1, bearing, seal and flange cover out of the pump housing, see Fig. 13.
3. Remove the feather key 866.
   3S 32 – 1700: Remove the circlip 471.2 and the supporting ring 056.
   3S 2200 – 2900:Remove the threaded ring 057 (without illustration).
   Remove the circlip 471.3, see Fig. 14.
4. Drive the main screw out of the flange cover with light blows from a plastic hammer.
5. Pull the ball bearing 817 out of the flange cover using a suitable extractor, see Fig. 15.
6. Remove the residues of the flat gasket 729.5 from the flange cover and pump housing.

5 Maintenance

Installing the ball bearing

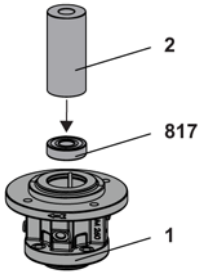


Fig. 16

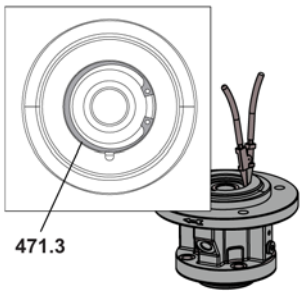


Fig. 17

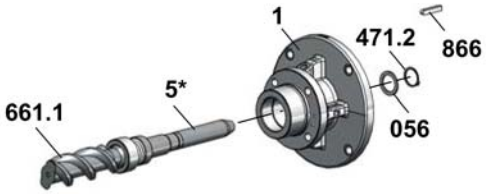


Fig. 18

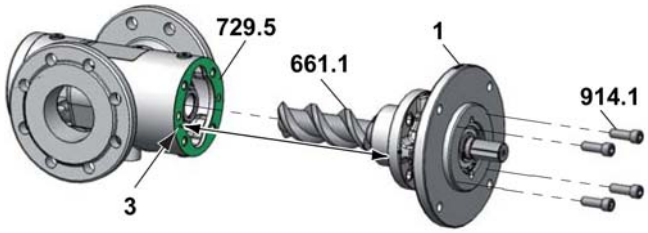


Fig. 19

1	Flange cover	471.2	Circlip
2	Mounting sleeve ball bearing	471.3	Circlip
3	Straight pin	661.1	Main screw
5*	Mountng sleeve flange cover	729.5	Flat gasket
055*	Supporting ring	817	Ball bearing
056	Supporting ring	866	Feather key
		914.1	Socket screw

* Only for 3S 581 - 2900
** Not for 3S 32 - 660

Aids:
- Tool set mechanical seal or radial shaft seal

1. Clean the fitting surfaces, grease the O-rings lightly.
2. Use the ball bearing mounting sleeve **2** to press the ball bearing **817** into the flange cover **1**, see Fig. 16, and fasten using the circlip **471.3**, see Fig. 17.
3. Turn the flange cover and place the supporting ring **055**** centered on the ball bearing (without illustration)
4. Slide the mains crew **661.1** into the flange cover. Take the alignment of the supporting ring **055**** into account.
   Notice: As of size 3S 851 (and mechanical seal version) use the flange cover mounting sleeve **5*** to this purpose, see Fig. 18.
5. 3S 32 – 1700: Mount the supportingring **056** and circlip **471.2**.
   3S 2200 – 2900: Mount the threaded ring **057** (without illustration).
   Mount the feather key, see Fig. 18.
6. Bond the new flat gasket **729.5** on the pump housing.
7. Slide the main screw with premounted flange cover into the pump housing until the main screw engages into the idle screws. Take the position of the straight pin **3** into account and turn the main screw, see Fig. 19.
8. Tighten the socket screws **914.1** with torque, see Tab. 9, page 45.

5.6 Replacing the screw set

Removing the screw set

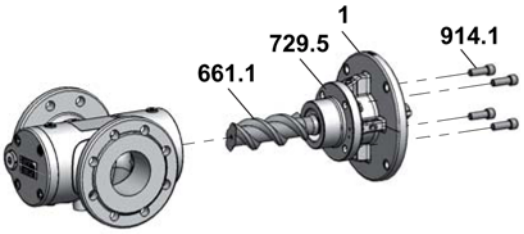


Fig. 20

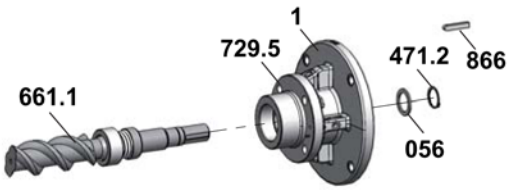


Fig. 21

Fig. 22

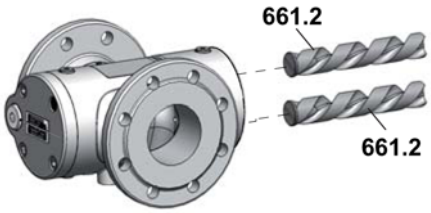


Fig. 23

1	Flange cover	**471.2**	Circlip
042	Balancing cylinder	**661.1**	Main screw
056	Supporting ring	**661.2**	Idle screw
062.1	Supporting ring	**729.5**	Flat gasket
457.1	Rotary seal ring with spring	**866**	Feather key
471.1	Circlip	**914.1**	Socket screw

Aids:
- Plastic hammer

1. Remove the socket screws **914.1** and loosen the flange cover **1** using light "rebound" blows.
2. Pull the withdrawable unit consisting of main screw **661.1**, bearing, seal and flange cover out of the pump housing, see Fig. 20.
3. Remove the feather key **866**.
   3S 32 – 1700: Remove the circlip **471.2**, remove the supporting ring **056**.
   3S 2200 – 2900: Remove the threaded ring **057** (without illustration).
4. Drive the main screw out of the flange cover with light blows from a plastic hammer, see Fig. 21.
5. Remove the rotary seal ring with spring **457.1**, supporting ring **062.1**, circlip **471.1** and balancing cylinder **042** from the mains crew, see Fig. 22.
6. Remove the idle screws **661.2** from the pump housing, see Fig. 23.
7. Remove the residues of the flat gasket **729.5** from the flange cover and pump housing.

5 Maintenance

Installing the screw set

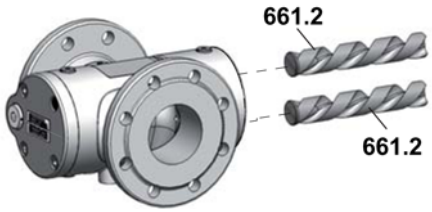


Fig. 24

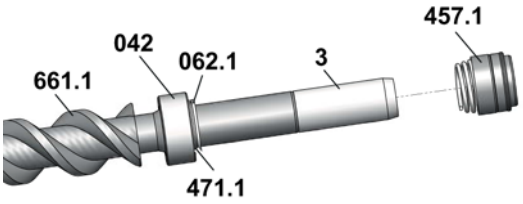


Fig. 25

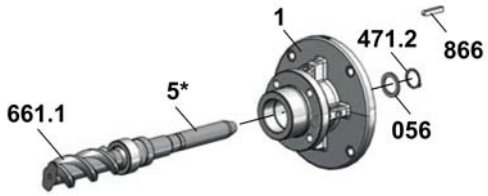


Fig. 26

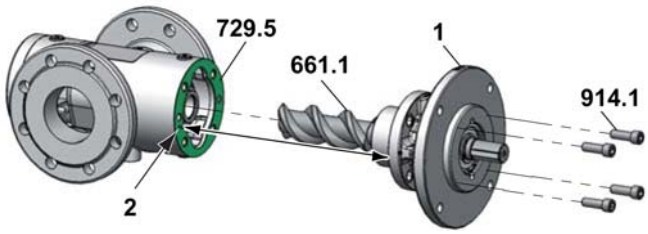


Fig. 27

1	Flange cover
2	Straight pin
3	Mounting sleeve main screw
5*	Mounting sleeve flange cover
042	Balancing cylinder
056	Supporting ring
062.1	Supporting ring
457.1	Rotary seal ring with spring
471.1	Circlip
471.2	Circlip
661.1	Main scrrew
661.2	Idle screw
729.5	Flat gasket
866	Feather key
914.1	Socket screw

* Only for 3S 851 - 2900

Aids

- Toolset mechanical seal or radial shaft seal

1. Clean the fitting surfaces, grease the O-rings lightly.
2. Insert the idle screws **661.2** into the pump housing, see Fig. 24.
3. Clean the main screw **661.1** around the mechanical seal carefully and grease it. Press the balancing cylinder **042** onto the main screw. Mount the circlip **471.1**, supporting ring **062.1** and rotary seal ring with spring **457.1**. Use the main screw mounting sleeve **3** to this purpose, see Fig. 25. Remove the mounting sleeve.
4. Slide the main screw with mounted rotary seal ring into the flange cover **1**.
   Notice: As of size 3S 851 (and mechanical seal version) use the flange cover mounting sleeve **5*** to this purpose, see Fig. 26.
5. 3S 32 – 1700: Mount the supporting ring **056** and circlip **471.2**.
   3S 2200 – 2900: Mount the threaded ring **057** (without illustration).
   Mount the feather key **866**, see Fig. 26
6. Bond the new flat gasket **729.5** on the pump housing.
7. Slide the main screw with premounted flange cover into the pump housing until the mains crew engages into the idle screws. Take the position of the straight pin **2** into account and turn the main screw, see Fig. 27.
8. Tighten the socket screws **914.1** with torque, see Tab. 9, page 45.

5.7 Possible faults

Faults can have different causes. The following tables list the symptoms of a fault, the possible causes and measures for elimination.

Fault	Cause/Remedy
- No pump suction	1, 2, 3, 4, 5, 6, 7, 8, 33
- Delivery rate too low	2, 3, 4, 9, 10, 11, 12, 13, 14, 15, 16
- Pump runs noisily	2, 3, 4, 6, 10, 12, 14, 18, 19, 20, 21, 22
- Motor overload	9, 10, 13, 22, 23
- Uneven delivery rate	2, 3, 4, 6, 10, 12, 14, 15
- Leaking shaft seal	17, 24, 25, 26, 27, 28
- Pump has got stuck	29, 30, 31, 32

5.8 Troubleshooting

No.	Cause	Remedy
1	Pump suction line closed	▶ Check shut-off devices in the suction line and open them, if necessary.
2	Suction valve or line obstructed	▶ Check the suction valve and line for clear passage.
3	Suction line or shaft seal leaks	▶ Check suction line or shaft seal for leaks. Pay particular attention to leakage at valves and connection points. If necessary, replace parts.
4	Suction head too high	▶ Reduce difference of level - or - Reduce line lenght - or - Increase pipe diameter - or - Healt the liquid to reduce viscosity - or - Install filter with greater mesh width. Ensure that the permissible mesh width is not exceeded, see”Cleaning the pipe system”, page 16
5	Level of liquid in the intake container too low	▶ Top up the pumped liquid.
6	Filter/strainer soiled	▶ Clean the filter/strainer.
7	Pump intake capacity reduced by inadequate wetting	▶ Fill pump with liquid.
8	Incorrect pump direction of rotation	▶ Carry out the electrical connection so that the direction of pump rotation matches that of the arrow on the flange cover, see "Connecting the motor", page 11.
9	Differential pressure too high	▶ Check the system and reduce the differential pressure.
10	Viscosity of the pumped liquid too high	▶ Increase the temperature of the pumped liquid. - or - Reduce the rotation speed
11	Viscosity of the pumped liquid too low	▶ Reduce the temperature of the pumped liquid. - or - Increase the rotation speed
12	Airlock or gas in the liquid	▶ Test the pipe system for air admission and replace parts if necessary. ▶ Reduce the suction head - or - Increase the inlet pressure
13	Motor running at wrong voltage or frequency	▶ Ensure that the motor voltage and frequency match the operating voltage. ▶ Compare the speed of the motor with the pump rating plate. If the data do not match, adjust the speed of the motor.

No.	Cause	Remedy
14	Overflow valve opens during normal operation	▶ Set the opening pressure above the value of operating pressure, see "Adjusting the overflow valve", page 19.
15	Overflow valve leaks	▶ Clean the overflow valve and if necessary, reseat.
16	Advanced wear of rotating pump components	▶ Check screw set and housing and replace if necessary.
17	Advanced wear of sealing surfaces	▶ Replace the seal and check the pumped liquid for abrasive content.
18	Inadequate alignment of shaft coupling	▶ Align the shaft coupling correctly, see "Assembling the pump and motor", page 10.
19	Pump deflected	▶ Support the weight of the pipe system. ▶ Loosen pipe connections and mount stress-free, see "Connecting the pump to the pipe system", page 10.
20	Resonance in the system	▶ Provide a flexible bearing arrangement for the pump unit. - or - Make the connections with hoses.
21	Speed of flow in suction or pressure line too high	▶ Set the flow speed in the suction line so that it does not exceed 1 m/s. ▶ Set the flow speed in the pressure line so that it does not exceed 3 m/s.
22	Ball bearing damaged	▶ Replace the ball bearing, see "Maintenance", page 22.
23	Lack of lubrication or foreign bodies have caused superficial damage to rotating pump components	▶ Check the screw set and the housing. If necessary replace the pump with free shaft end.
24	Dry running has damaged the shaft seal	▶ Replace the shaft seal, see "Maintenance", page 22. When starting up the pump, pay attention to venting.
25	Inlet pressure too high	▶ Reduce the inlet pressure at the system-side.
26	Thermal or chemical loading of elastomer seals exceeded	▶ Check the maximum operating temperature. ▶ Check the resistance of the elastomers with regard to the pumped liquid.
27	Cold start when delivering high-viscosity liquids	▶ Install the heating system.
28	Seal overload during heating process	▶ To prevent thermal expansion of the liquid causing a build-up of pressure, open the pressure- or suctionside shut-off device.
29	Foreign bodies in the pump	▶ Dismantle the pump and clean it. ▶ Smooth the superficial damage to the housing and the rotating parts with an oilstone. If necessary, replace the pump.
30	Differential pressure is too high and has overloaded the idle screws	▶ Dismantle the pump and clean it. ▶ Smooth the superficial damage to the housing and the rotating parts with an oil stone. If necessary, replace the pump. ▶ Reduce the differential pressure.
31	Viscosity is too low and has overloaded the idle screws	▶ Dismantle the pump and clean it. ▶ Smooth the superficial damage to the housing and the rotating parts with an oilstone. If necessary, replace the pump. ▶ Increase the viscosity, for example by reducing the operating temperature.
32	Dry running can damage pump equipment	▶ Dismantle the pump and clean it. ▶ Smooth the superficial damage to the housing and the rotating parts with an oil stone. If necessary, replace the pump. ▶ When resuming operation, take action to prevent dry running, see "Recommissioning the pump", page 21.
33	Pump does not vent	▶ Vent the pressure line at the highest point.

Fig. 2 Fault table

6.1 Type code

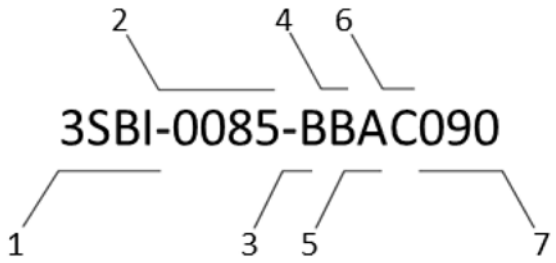


Fig. 1 Type code

Item	Designation	Type	
1	Model	3SBI	Pump with free shaft end Pump housing with flanges PN16 in inline configuration Pump unit with or without pump bracket foot
		3SBS	Pump with free shaft end Pump housing with overhead special flanges PN16 Pump unit with or without pump bracket foot
		3SBT	Pump with free shaft end Pump housing with overhead flanges PN16 Pump unit with or without pump bracket foot
		3SVI	Pump with pedestal for vertical mounting Pump housing with flanges PN16 in inline configuration Pump unit on pedestal
		3SVT	Pump with pedestal for vertical mounting Pump housing with overhead flanges PN16 Pump unit on pedestal
2	Size	Corresponds to flow rate in [l/min] at 1450 min^{-1}	
3	Shaft seal	B: Mechanical seal of hard material D: Magnetic coupling	
4	Pressure stage overflow valve	A: Pressure stage 3.0–5.9 bar B: Pressure stage 6.0–9.9 bar C: Pressure stage 10–16 bar	
5	Heating system	A: Without heating system B: Electric heating system C: Fluid heating system	
6	Completion	A: Pump with free shaft end B: With adaptor housing and coupling (flange mounted) C: With adaptor housing, coupling and foot (foot mounted) D: B with motor E: C with motor	
7	Frame size	071 080 090 100 112 132	160 180 200 225 250 280

Tab. 1 Type code

6 Technical data

6.2 Name plate

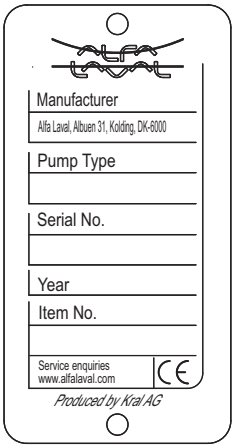


Fig.2 Name plate

6.3 Operating limits

	Size 5 - 20	32 - 42	55 - 118	160 - 275	370 - 450	550 - 660	851 - 1301	1500 - 1700	2200 - 2900
Operating pressure max. [bar]									
- Pump housing with PN6 flange	6								
- Pump housing with PN16 flange	16								
Temperature of the pumped liquid max. [°C]									
- Mechanical seal of hard material	180								
Ambient temperature [°C]	-10 ...50								
Viscosity min. – max. [mm2/s]	2 - 10000								
Rotation speed [min-1]									
- At 50 Hz	2900/1450								
- At 60 Hz	3500/1750								
Feed pressure [bar]									
- Mechanical seal of hard material	6								

Tab. 2 Operating limits

6.4 Sound pressure level

Guide values at 1m distance, 1450 min^{-1},10 bar

	Size 5 - 20	32 - 42	55 - 118	160 - 275	370 - 450	550 - 660	851 - 1301	1500 - 1700	2200 - 2900
	Sound pressure level max. ±3 [dB(A)]								
Pump	52.0	55.0	60.0	65.0	68.0	71.0	76.0	78.5	83.0
Motor max.	55.0	55.0	62.0	64.0	64.0	68.0	69.0	69.0	69.0
Pump + motor	57.0	58.0	64.0	68.0	70.0	73.0	77.0	79.0	83.0

Tab. 3 Sound pressure level

6.5 Required NPSH values

The following table lists the required NPSH values during operation with a low-volatile liquid such as lubricating oil or hydraulic liquid. When liquids have a readily volatile component content, there quired NPSH values increase notably:
- Fuel oil requires an NPSH value of at least 6 mWC.
- In the case of liquids that contain water (e.g. heavy fuel oil) the values in the table have to increased by the vapor pressure of the water at the specified operating temperature.
The equired NPSH values also needs to be increased if there are gas contents, regardless of whether it is dissolved or not. In case of any doubt, please contact the manufacturer.

Size	Viscosity [mm²/s]	NPSH value [mWC] at Rotation speed [min⁻¹] 1450	1750	2900	3500	Size	Viscosity [mm²/s]	NPSH value [mWC] at Rotation speed [min⁻¹] 1450	1750	2900	3500
3S 5	6	2.0				3S 275	6	2.3		4.5	6.1
	37	2.0					37	2.5	2.9	5.1	7.0
	152	2.0					152	3.0	3.5	6.3	-
	380	2.0					380	3.6	4.2	-	
3S 7.5	6	2.0				3S 370	6	2.2		4.2	5.7
	37	2.0					37	2.5	2.8	4.8	6.5
	152	2.0					152	2.9	3.3	5.9	-
	380	2.0		2.3	2.6		380	3.6	4.0	-	
3S 10	6	2.0				3S 450	6	2.5	3.0	5.8	8.3
	37	2.0					37	2.8	3.3	6.7	-
	152	2.0			2.3		152	3.3	4.0	-	
	380	2.0		2.6	3.1		380	4.0	4.9	-	
3S 15	6	2.0				3S 550	6	2.4	2.8	5.0	7.1
	37	2.0					37	2.7	3.1	5.8	-
	152	2.0			2.2		152	3.2	3.7	7.2	-
	380	2.0		2.7	3.0		380	3.9	4.5	-	
3S 20	6	2.0				3S 660	6	2.8	3.4	7.4	-
	37	2.0					37	3.1	3.8	-	
	152	2.0		2.4	2.7		152	3.8	4.6	-	
	380	2.0	2.4	3.2	3.8		380	4.6	5.8	-	
3S 32	6	2.0				3S 851	6	3.2	3.7	-	
	37	2.0					37	3.5	4.1	-	
	152	2.0		2.3	2.6		152	4.1	4.4	-	
	380	2.0	2.4	3.1	3.7		380	4.8	5.8	-	
3S 42	6	2.0			2.3	3S 951	6	3.6	4.4	-	
	37	2.0		2.1	2.6		37	4.0	4.9	-	
	152	2.0		2.8	3.5		152	4.8	5.9	-	
	380	2.0	2.7	4.0	4.8		380	5.8	7.3	-	
3S 55	6	2.0				3S 1101	6	3.0	3.7	-	
	37	2.0			2.7		37	3.4	4.2	-	
	152	2.1		2.8	3.3		152	4.1	5.1	-	
	380	2.5	2.7	3.5	4.0		380	5.0	6.3	-	
3S 74	6	2.0		2.6	3.0	3S 1301	6	4.0	5.0	-	
	37	2.0		2.9	3.4		37	4.5	5.7	-	
	152	2.3	2.5	3.3	4.0		152	5.4	6.8	-	
	380	2.7	3.0	4.4	5.0		380	7.0	-		
3S 85	6	2.0		2.8	3.4	3S 1500	6	4.3	5.7	-	
	37	2.0		3.1	3.8		37	4.8	6.9	-	
	152	2.4	2.4	3.8	4.6		152	5.6	-		
	380	2.8	2.8	4.6	5.8		380	-			
3S 105	6	2.0		2.7	3.2	3S 1700	6	5.5	6.8	-	
	37	2.0	2.2	3.0	3.6		37	6.0	7.5	-	
	152	2.4	2.6	3.6	4.4		152	7.0	-		
	380	2.8	3.1	4.4	5.4		380	-			
3S 118	6	2.0		3.1	3.9	3S 2200	6	3.6	4.7	-	
	37	2.2		3.5	4.4		37	4.0	5.3	-	
	152	2.5	2.8	4.3	5.4		152	5.0	6.6	-	
	380	3.0	3.3	5.3	6.8		380	6.2	-		
3S 160	6	2.0		2.9	3.6	3S 2500	6	4.2	5.7	-	
	37	2.0		3.3	4.0		37	4.8	6.5	-	
	152	2.5	2.7	3.9	5.0		152	5.9	8.1	-	
	380	2.9	3.2	4.9	6.2		380	7.4	-		
3S 210	6	2.1		4.0	5.2	3S 2900	6	5.0	7.0	-	
	37	2.4	2.7	4.5	6.0		37	5.8	8.2	-	
	152	2.8	3.2	5.5	-		152	7.2	-		
	380	3.5	4.0	6.9	-		380	-			
3S 235	6	2.0		3.5	4.5						
	37	2.3	2.5	4.0	5.1						
	152	2.7	3.0	4.9	-						
	380	3.2	3.6	-							

Tab. 4 Required NPSH values

6 Technical data

6.6 Weights

Model 3SBI/3SBS/3SBT

Motor size	Size 5 7.5 10	15 20	32 42	55 74 85	105 118	160 210	235 275	370 450	550 660	851 951	1101 1301	1500 1700	2200 2500 2900
	Weight of pump with free shaft end [kg]												
	8.0	8.0	10.5	21.5	21.5	36.5	36.5	50.0	85.5	154.0	154.0	310.0	430.0
	Weight of pump bracket with pump bracket foot, coupling and screws [kg]												
71	3.0	3.0	4.6	-									
80	4.0	4.0	4.0	4.0	4.0	-							
90S	4.0	4.0	4.0	4.0	4.0	-							
90L	4.0	4.0	4.0	4.0	4.0	-							
100L	5.0	5.0	4.0	4.0	4.0	4.0	4.0	-					
112M	-		4.0	4.0	4.0	4.0	4.0	-					
132S	-			5.0	5.0	6.0	6.0	6.5	22.5	-			
132M	-			5.0	5.0	6.0	6.0	6.5	22.5	-			
160M	-			7.5	7.5	10.0	10.0	8.5	9.5	30.0	30.0	28.0	28.0
160L	-			7.5	7.5	10.0	10.0	8.5	9.5	30.0	30.0	28.0	28.0
180M	-					12.0	12.0	8.5	9.5	30.0	30.0	28.0	28.0
180L	-					12.0	12.0	8.5	9.5	30.0	30.0	28.0	28.0
200L	-							16.0	15.5	35.0	35.0	32.0	32.0
225M	-								14.0	41.5	41.5	45.0	50.0
250M	-								50.0	82.0	82.0	50.0	55.0
280S	-									54.0	54.0	55.0	60.0
280M	-									54.0	54.0	55.0	60.0

Tab.5 3SBI/3SBS/3SBT weights

Model 3SVI/3SVT

Motor size	Size 5 7.5 10	15 20	32 42	55 74 85	105 118	160 210	235 275	370 450	550 660	851 951	1101 1301	1500 1700	2200 2500 2900
	Weight of pump with free shaft end [kg]												
	8.0	8.0	10.5	21.5	21.5	36.5	36.5	50.0	85.5	154.0	154.0	310.0	430.0
	Weight of the pedestal[kg]												
	2.2	2.2	2.7	2.9	2.9	8.6	8.6	8.2	17.8	27.1	27.1	62.2	70.0
	Weight of pump bracket with coupling and screws [kg]												
71	1.6	1.6	3.3	-									
80	3.5	3.5	3.5	3.5	3.5	-							
90S	3.5	3.5	3.5	3.5	3.5	-							
90L	3.5	3.5	3.5	3.5	3.5	-							
100L	4.5	4.5	3.0	3.0	3.0	3.0	3.0	-					
112M	-		3.0	3.0	3.0	3.0	3.0	-					
132S	-			4.0	4.0	4.0	4.0	3.5	19.5	-			
132M	-			4.0	4.0	4.0	4.0	3.5	19.5	-			
160M	-			5.5	5.5	3.0	3.0	5.5	6.5	27.0	27.0	-	
160L	-			5.5	5.5	3.0	3.0	5.5	6.5	27.0	27.0	-	
180M	-					8.0	8.0	7.0	8.0	27.0	27.0	-	
180L	-					8.0	8.0	7.0	8.0	27.0	27.0	-	
200L	-							10.5	10.0	30.0	30.0	-	
225M	-								13.0	42.0	42.0	47.0	47.0
250M	-								21.5	53.0	53.0	52.0	52.0
280S	-									54.0	54.0	56.0	56.0
280M	-									54.0	54.0	56.0	56.0

Tab.6 3SVI/3SVT weights

6.7 Structure

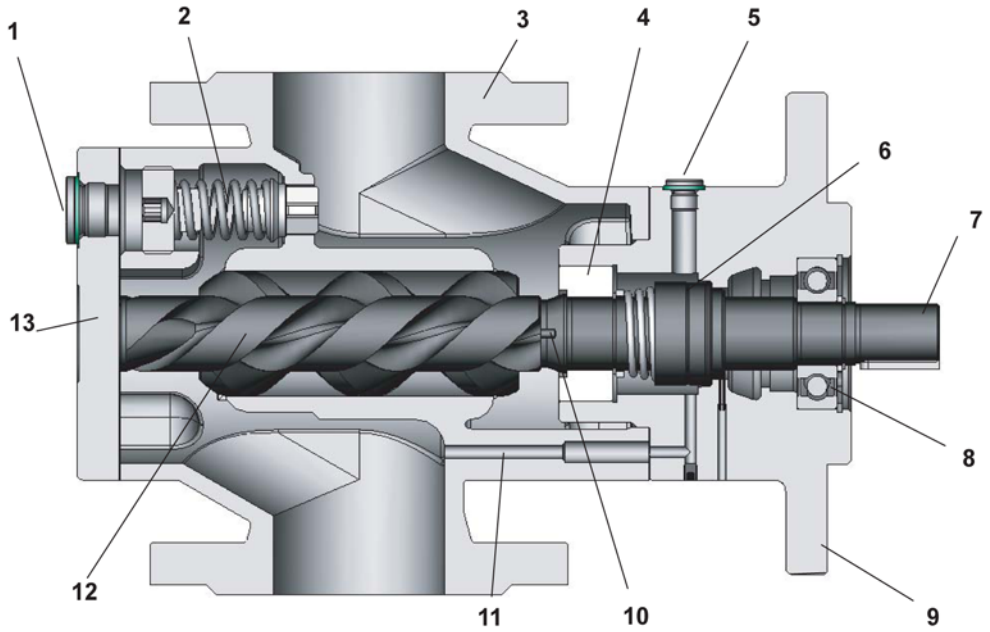


Fig. 3 Structure of 3S-pump

1. Screw plug
2. Overflow valve
3. Pump housing
4. Balancing cylinder
5. Sealing space vent
6. Mechanical seal
7. Main screw
8. Ball bearing
9. Flange cover
10. Thrust pin
11. Relief line
12. Idle screw
13. End cover

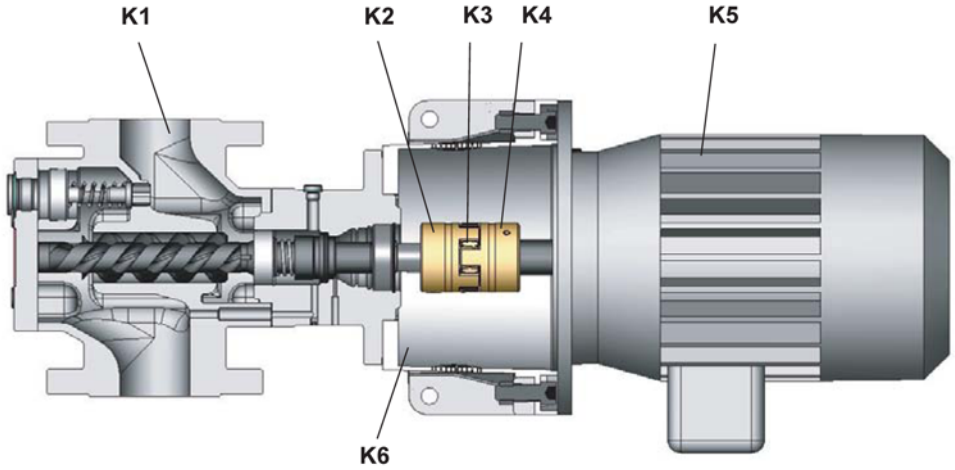


Fig. 4 Structure of 3S-pump with completion

K1 Pump
K2 Pump-side coupling half
K3 Coupling intermediate ring
K4 Motor-side coupling half
K5 Motor
K6 Pump bracket

6 Technical data

Screw pumps are rotating displacement pumps whose displacement effect results from the meshing of three rotating screws and the enclosing housing. The radial support of the screws is effected by the sliding contact in the housing which requires lubrication by the pumped liquid. Screw pumps are therefore not suitable for dry running and can only be used up to specific pressure and viscosity limits. Due to the narrow tolerances, pumping of suspended solids is not possible.
Axial support of the main screw is carried out by a lifetime lubricated deep-groove ball bearing. Different shaft seals are available for sealing the main screw at the outlet from the housing. In order to reduce the pressure at the shaft seal a balancing cylinder is mounted at the main screw. The sealing chamber is connected to the suction chamber though a relief line. An integrated overflow valve protects against excessive pressure that could cause housing parts to burst.

Standard direction of rotation:	Clockwise, viewed from the drive Marked on the housing by an arrow, see Fig. 2, page 18.
Direction of flow:	Marked on the housing by two arrows, see Fig. 2, page 18.

6.8 Housing variants

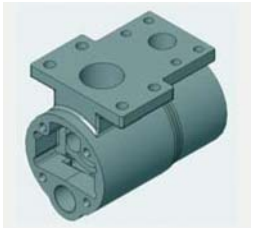
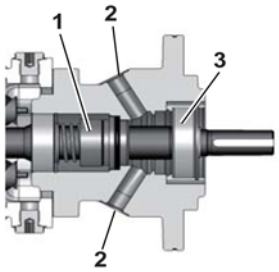
Housing	Series	Description
	3SBI / 3SVI	Pump housing with flanges PN16 in inline configuration
	3SBT/ 3SVT	Pump housing with overhead flages PN6/PN16
	3SBS	Pump housing with overhead special flanges PN16

Fig. 7 Housing variants

6.9 Shaft seal

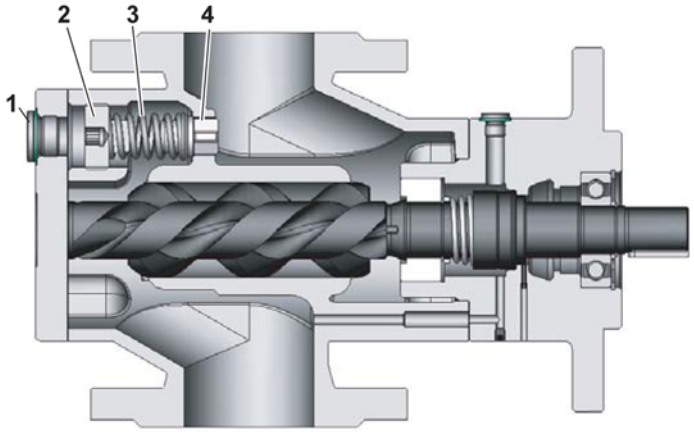
The following types of shaft seals are used:

- Mechanical seal, hard material

Seal		Description
 Mechanical seal	1. Mechanical seal 2. Leakage vent hole 3. Ball bearing	The lubrication of the mechanical seal inevitably results in minimal leakage that as a rule evaporates and is therefore not conspicuous. However, with low-volatile liquids such as heavy oil, the leakage will be visible. The included leakage venthole **2** allows draining of this leakage. The drainage through these holes has to be kept free, see "Cleaning leakage vent holes", page 23. Dry running must be avoided at all costs, as the seal will overheat and be destroyed in a matter of minutes.

Tab. 8 Seal description

6.10 Overflow valve



1. Screw plug
2. Adjusting screw
3. Spring
4. Valve body

Fig. 5 Overflow valve mounting position

The integrated overflow valve ensures that very high pressures that could result in housing parts bursting do not result. The valve is purely there as a safety element and should not be used for control or regulation such as maintaining pressure. If the valve is kept open for too long under adverse operating conditions (high differential pressures and/or low viscosities) it will only take a few minutes for the valve and the valve seating to become damaged. As a result, the valve will leak permanently and there will be a corresponding reduction in the delivery rate. In addition to this, circulation through the overflow valve for too long heats the pump to excess. This reduces viscosity and can ultimately lead to pump failure.
It therefore has to be ensured at the system that the maximum operating pressure always lies under the operating pressure of the overflow valve.

Factory setting:
- 110% of the nominal pressure
The valve is accessible via a screw plug **1** and can be adjusted from the outside, see "Adjusting the overflow valve", page 19.

6.11 Tightening torques

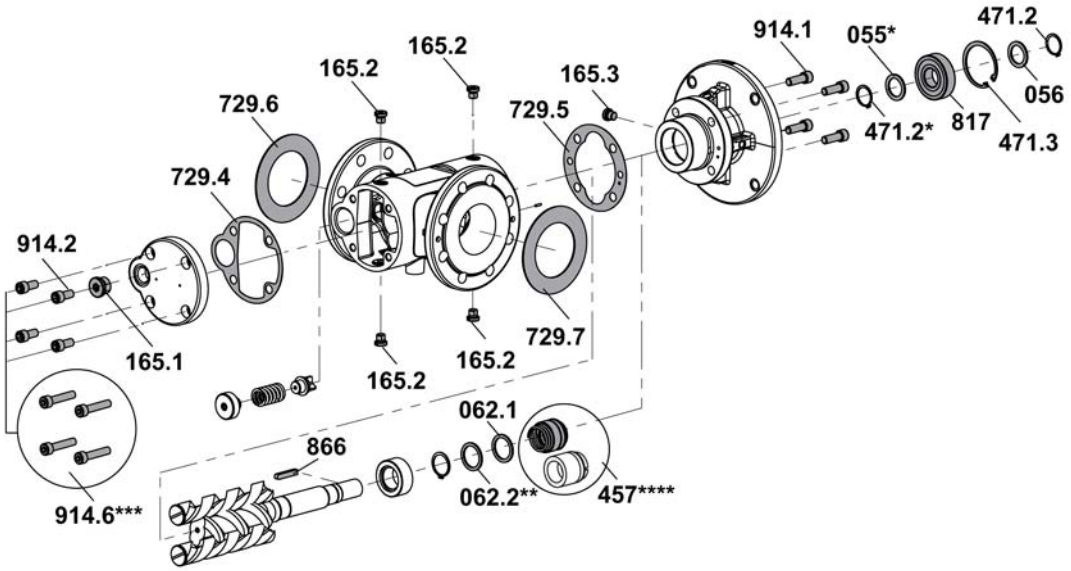
Tightening torque [Nm] for screws with metric threads + head contact surfaces								with thread measured in inches Screw plugs with elastomer seal	
				+ wedge lock washers		Stainless steel screws A2 and A4			
Thread	8.8	10.9	8.8 + Alu*	8.8	Rust-prood A4-70	Property class 70	Property class 80	Thread	Galvanized + stainless steel
M 3	1.5	-	1.2	1.5	1.1	-	-	G 1/8”	13
M 4	2.9	4.1	2.3	3	2	-	-	G 1/4”	30
M 5	6.0	8.0	4.8	6.0	3.9	3.5	4.7	G 3/8”	60
M 6	9.5	14	7.6	10.3	6.9	6	8	G 1/2”	80
M 8	23.1	34	18.4	25	17	16	22	G 3/4”	120
M 10	46	68	36.8	47	33	32	43	G 1”	200
M 12	80	117	64	84	56	56	75	G 1 1/4”	400
M 14	127	186	101	133	89	-	-	G 1 1/2”	450
M 16	194	285	155	204	136	135	180		
M 18	280	390	224	284	191	-	-	* Reduced tightening torque when screwing into aluminum	
M 20	392	558	313	399	267	280	370		
M 24	675	960	540	687	460	455	605		

Tab. 9 Tightening torques

7.1 Maintenance sets

NOTE
The maintenance sets contain only the numbered parts and are only supplied complete.

Mechanical seal, hard material 3SBI/3SVI 5 – 660

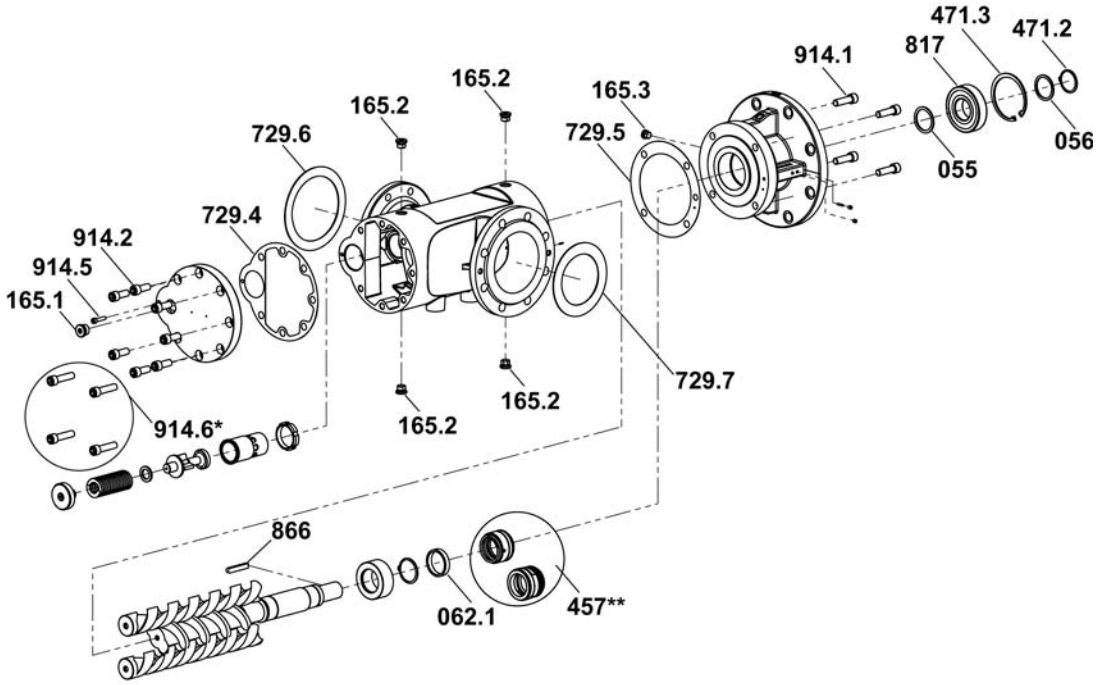


Qty.	Pos. no.	Part	Qty.	Pos. no.	Part
1	055*	Supporting ring	1	729.4	Flat gasket
1	056	Supporting ring	1	729.5	Flat gasket
1	062.1	Supporting ring	1	729.6	Flat gasket, suction flange
1	062.2*	Supporting ring	1	729.7	Flat gasket, pressure flange
1	165.1	Screw plug	1	817	Ball bearing
4	165.2	Screw plug	1	866	Feather key
1	165.3	Screw plug	4	914.1	Socket screw
1	457****	Mechanical seal	4	914.2	Socket screw
1	471.2	Circlip	4	914.6***	Socket screw
1	471.2*	Circlip	1		Silicone grease 1 g
1	471.3	Circlip			

* Only for 3S 5 - 20
** Not for 3S 32 - 118
*** Only for 3SVI: replaces 914.2
**** Hard material

7 Spare parts

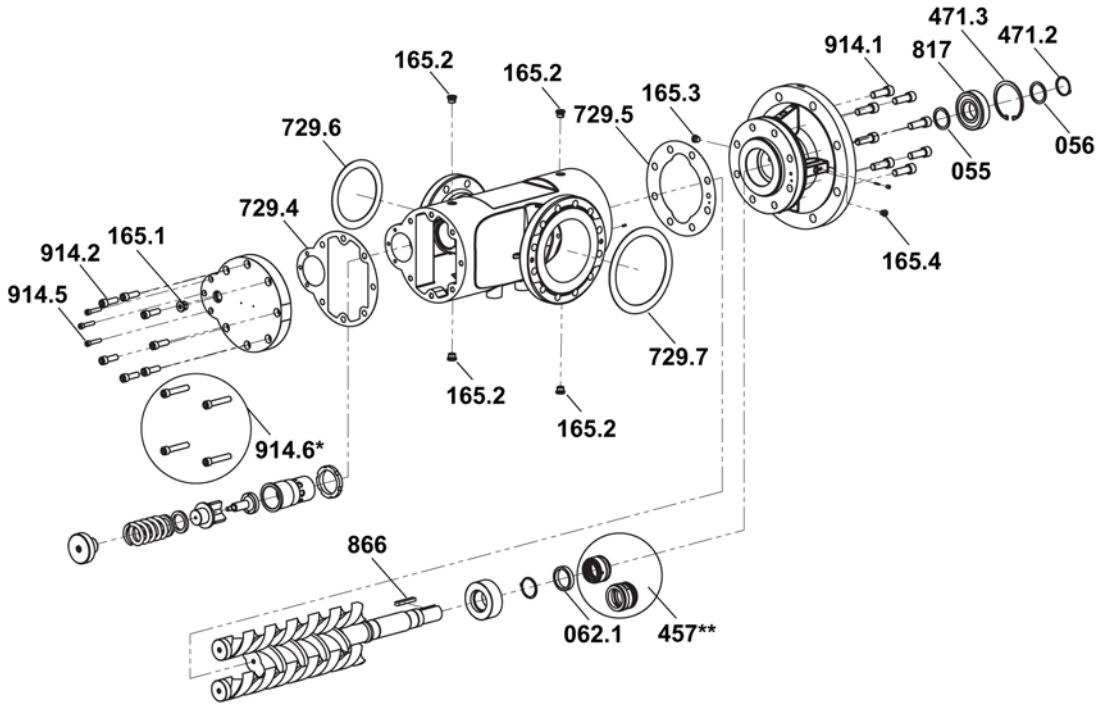
Mechanical seal, hard material 3SBI/3SVI 851 – 1301



Qty.	Pos. no.	Part	Qty.	Pos. no.	Part
1	055	Supporting ring	1	729.5	Flat gasket
1	056	Supporting ring	1	729.6	Flat gasket, suction flange
1	062.1	Supporting ring	1	729.7	Flat gasket, pressure flange
1	165.1	Screw plug	1	817	Ball bearing
4	165.2	Screw plug	1	866	Feather key
1	165.3	Screw plug	4	914.1	Socket screw
1	457**	Mechanical seal	7	914.2	Socket screw
1	471.2	Circlip	1	914.5	Socket screw
1	471.3	Circlip	4	914.6*	Socket screw
1	729.4	Flat gasket	2		Silicone grease 1 g

* Only for 3SVI: replaces 4 pieces 914.2
** Hard material

Mechanical seal, hard material 3SBI/3SVI 1500 – 1700

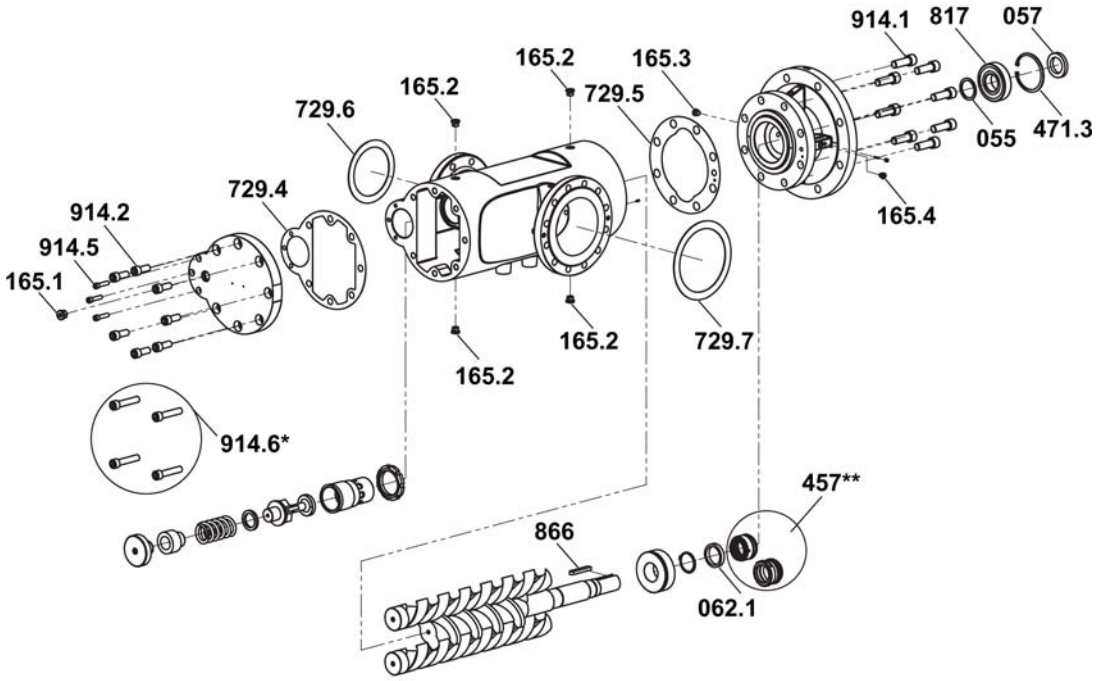


Qty.	Pos. no.	Part	Qty.	Pos. no.	Part
1	055	Supporting ring	1	729.5	Flat gasket
1	056	Supporting ring	1	729.6	Flat gasket, suction flange
1	062.1	Supporting ring	1	729.7	Flat gasket, pressure flange
1	165.1	Screw plug	1	817	Ball bearing
4	165.2	Screw plug	1	866	Feather key
1	165.3	Screw plug	8	914.1	Socket screw
1	165.4	Screw plug	7	914.2	Socket screw
1	457**	Mechanical seal	3	914.5	Socket screw
1	471.2	Circlip	4	914.6*	Socket screw
1	471.3	Circlip	2		Silicone grease 1 g
1	729.4	Flat gasket			

* Only for 3SVI: replaces 4 pieces 914.2
** Hard material

7 Spare parts

Mechanical seal, hard material 3SBI/3SVI 2200 – 2900



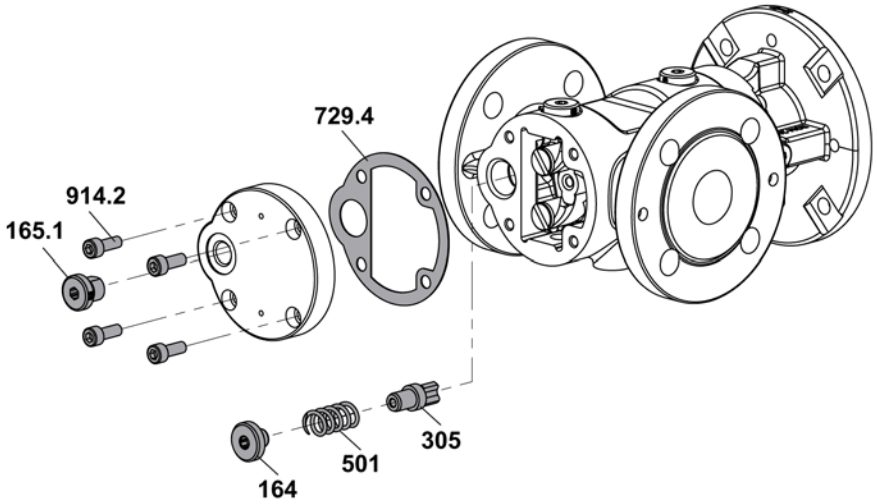
Qty.	Pos. no.	Part	Qty.	Pos. no.	Part
1	055	Supporting ring	1	729.5	Flat gasket
1	057	Threaded ring	1	729.6	Flat gasket, suction flange
1	062.1	Supporting ring	1	729.7	Flat gasket, pressure flange
1	165.1	Screw plug	1	817	Ball bearing
4	165.2	Screw plug	1	866	Feather key
1	165.3	Screw plug	8	914.1	Socket screw
1	165.4	Screw plug	7	914.2	Socket screw
1	457**	Mechanical seal	3	914.5	Socket screw
1	471.3	Circlip	4	914.6*	Socket screw
1	729.4	Flat gasket	2		Silicone grease 1 g

* Only for 3SVI: replaces 4 pieces **914.2**
** Hard material

7.2 Repair sets

NOTE
The repair sets contain only the numbered parts and are only supplied complete.

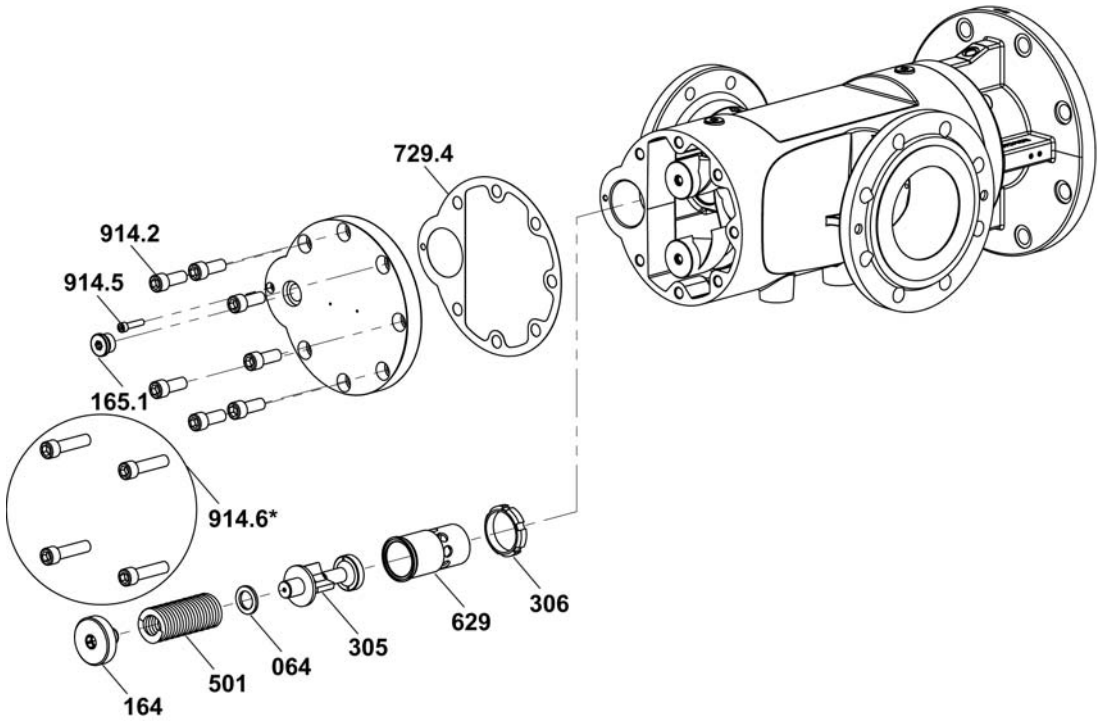
Overflow valve 3SBI/3SVI 5 – 660



Qty.	Pos. no.	Part	Qty.	Pos. no.	Part
1	164	Adjustning screw	1	501	Spring
1	165.1	Screw plug	1	729.4	Flat gasket
1	305	Valve body	4	914.2	Socket screw

7 Spare parts

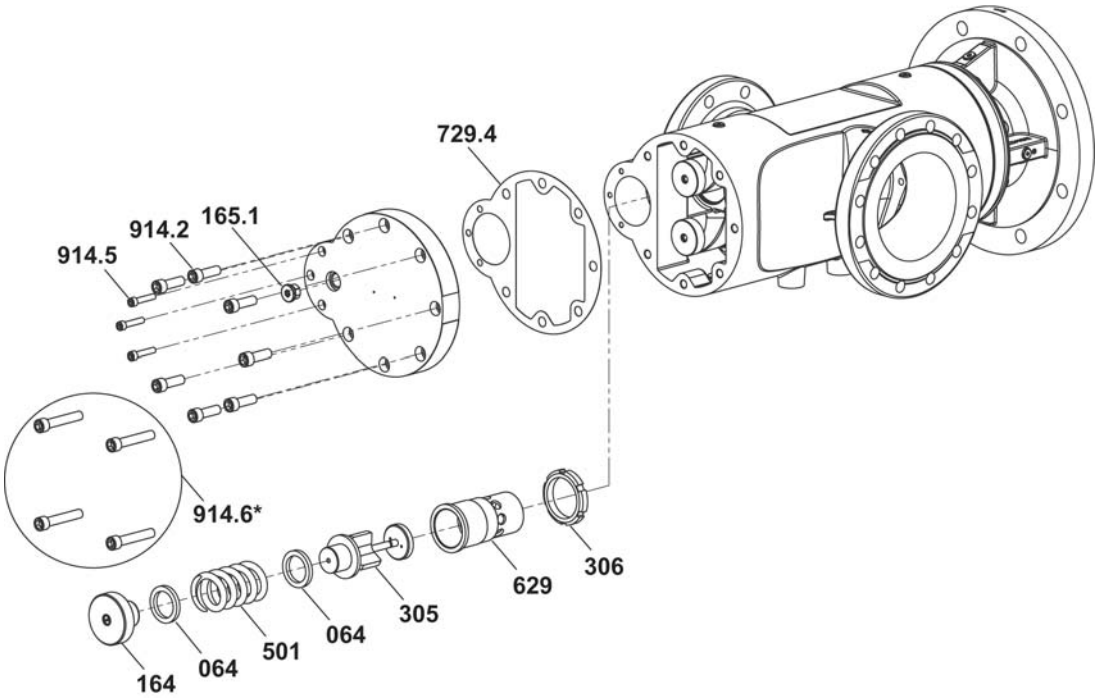
Overflow valve 3SBI/3SVI 851 – 1301



Qty.	Pos. no.	Part	Qty.	Pos. no.	Part
1	064	Supporting ring	1	629	Valve housing
1	164	Adjusting screw	1	729.4	Flat gasket
1	165.1	Screw plug	7	914.2	Socket screw
1	305	Valve body	1	914.5	Socket screw
1	306	Groove nuts	4	914.6*	Socket screw
1	501	Spring			

* Only for 3SVI: replaces 4 pieces 914.2

Overflow valve 3SBI/3SVI 1500 – 1700

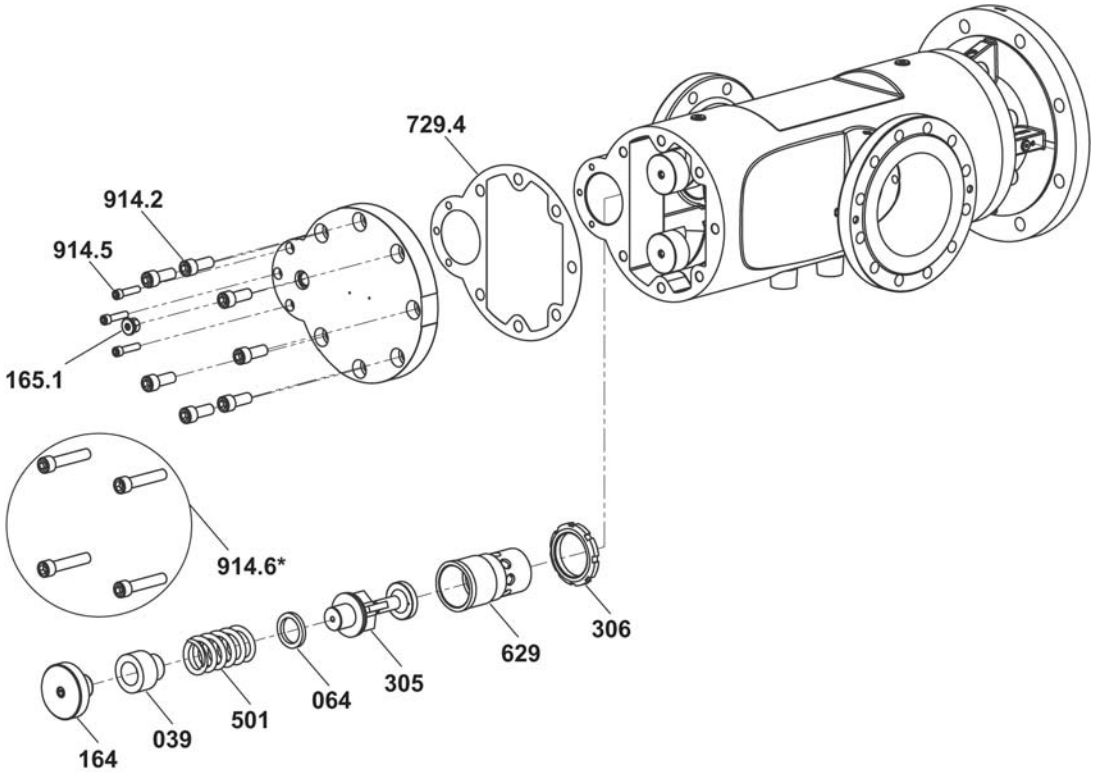


Qty.	Pos. no.	Part	Qty.	Pos. no.	Part
2	064	Supporting ring	1	629	Valve housing
1	164	Adjusting screw	1	729.4	Flat gasket
1	165.1	Screw plug	7	914.2	Socket screw
1	305	Valve body	3	914.5	Socket screw
1	306	Groove nuts	4	914.6*	Socket screw
1	501	Spring			

* Only for 3SVI: replaces 4 pieces **914.2**

7 Spare parts

Overflow valve 3SBI/3SVI 2200 – 2900

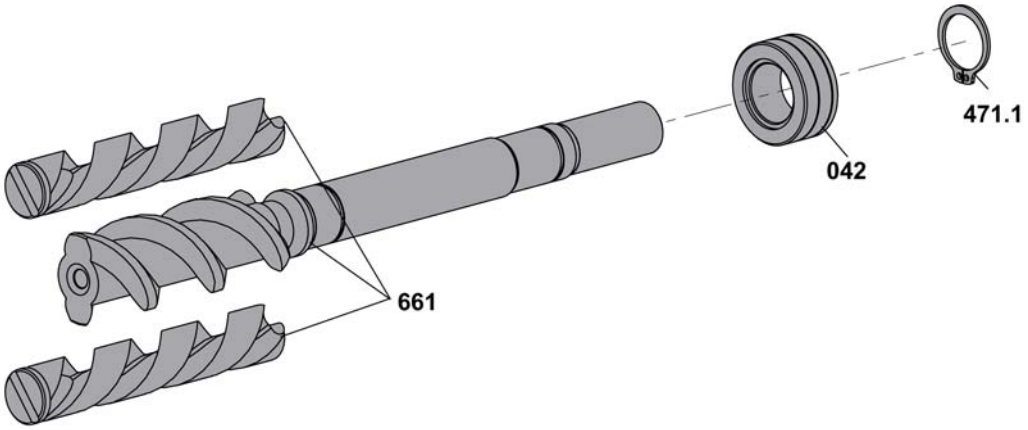


Qty.	Pos. no.	Part	Qty.	Pos. no.	Part
1	039	Sleeve	1	501	Spring
1	064	Supporting ring	1	629	Valve housing
1	164	Adjusting screw	1	729.4	Flat gasket
1	165.1	Screw plug	7	914.2	Socket screw
1	305	Valve body	3	914.5	Socket screw
1	306	Groove nut	4	914.6*	Socket screw

* Only for 3SVI: replaces 4 pieces **914.2**

Screw set

NOTE
The repair set, screw set is only supplied in combination with a maintenance set.

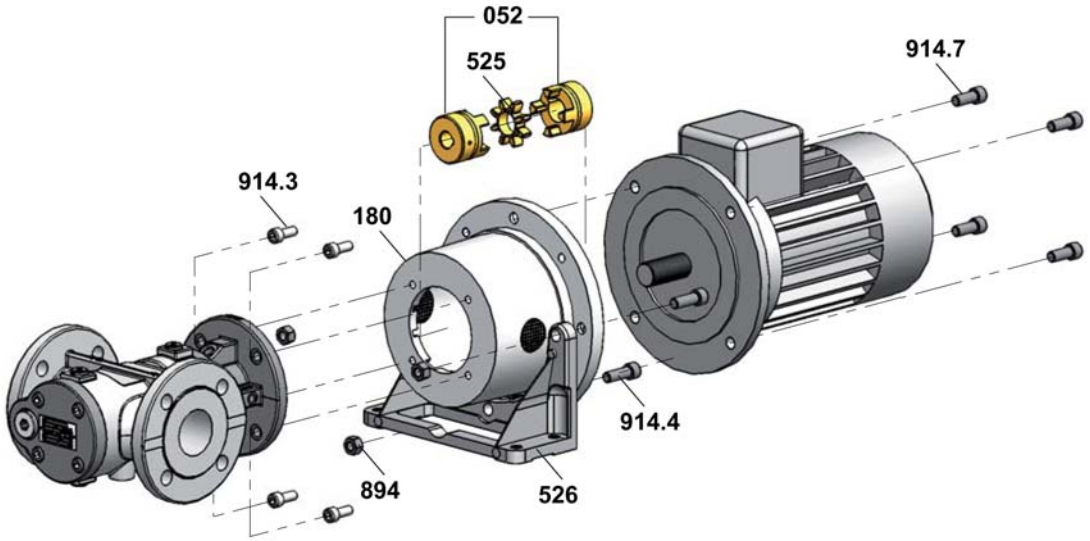


Qty.	Pos. no.	Part	Qty.	Pos. no.	Part
1	042	Balancing cylinder	1	661	Screw set
1	471.1	Circlip			

7 Spare parts

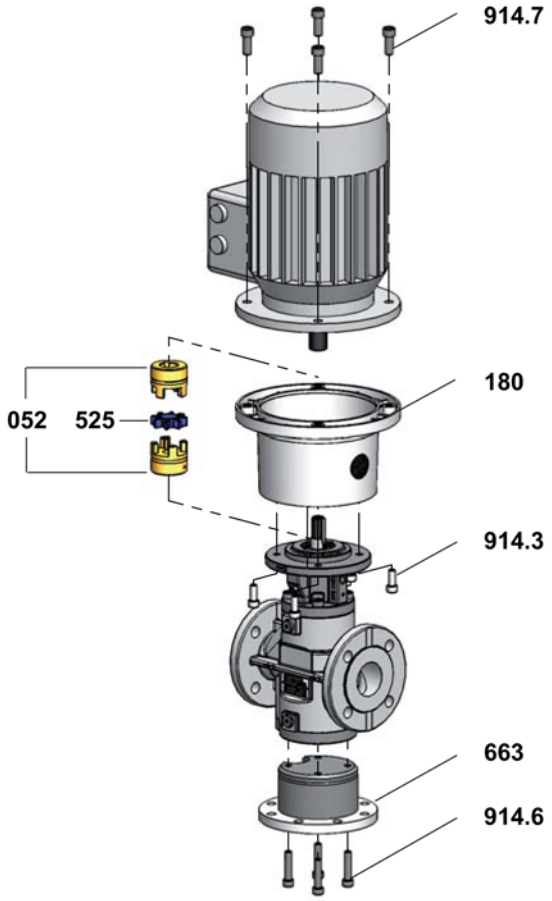
7.3 Completions

Model 3SBI



Pos. no.	Part	Pos. no.	Part
052	Coupling	894	Hexagon nut
180	Pump bracket	914.3	Socket screw
525	Coupling intermediate ring	914.4	Socket screw
526	Pump bracket foot	914.7	Socket screw

Model 3SVI



Pos. no.	Part	Pos. no.	Part
052	Coupling	914.3	Socket screw
180	Pump bracket	914.6	Socket screw
525	Coupling intermediate ring	914.7	Socket screw
663	Pedestal		

7 Spare parts

7.4 Accessories

Tool sets for 3SBI/3SVI/3SBT

Tool set, mechanical seal		
	Qty.	Part
	1	Mounting arbor stationary seal ring
	1	Mounting sleeve main screw
	1	Mounting sleeve ball bearing
	1	Mounting sleeve flange cover Only for 3S851 – 2900

Tool set, radial shaft seal		
	Qty.	Part
	1	Mounting arbor radial seal ring
	1	Mounting sleeve main screw
	1	Mounting sleeve ball bearing

7 Spare parts

How to contact Alfa Laval
Contact details for all countries are
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Please visit www.alfalaval.com to access the information directly.