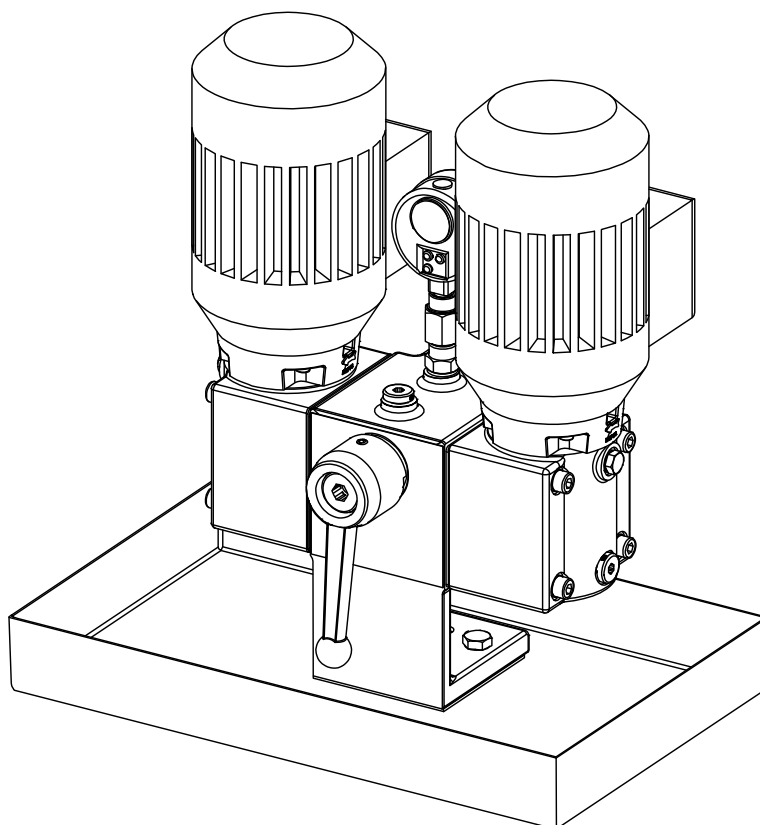




Operating instructions

KRAL



KRAL pump stations.

Series DL2

Mechanical seal/Radial shaft seal

OID 05en-GB
Edition 2024-07
Original instructions

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1 About this document

1.1 General information

1 About this document

1.1 General information

These instructions form part of the product and must be kept for future reference. Furthermore please observe the associated documents.

1.2 Associated documents

- ☐ Declaration of conformity according to EU Directive 2006/42/EC
- ☐ Manufacturer's declaration according to EU Directive 2014/68/EU
- ☐ Technical documentation of the supplied components

1.3 Target groups

The instructions are intended for the following persons:

- ☐ Persons who work with the product
- ☐ Operator-owners who are responsible for the use of the product

Persons who work with the product must be qualified. The qualification ensures that possible dangers and material damage that are connected to the activity are detected and avoided. These persons are qualified personnel who carry out the work properly due to their training, knowledge and experience and on the basis of the relevant provisions.




Information on the required qualification of the personnel is provided separately at the beginning of the individual chapters in these instructions. The following table provides an overview.

Target group	Activity	Qualification
Transport personnel	Transporting, unloading, setting up	Qualified personnel for transport, mobile crane operators, crane operators, forklift operators
Fitter	Mounting, connection	Qualified personnel for mounting
Electrician	Electrical connection	Qualified personnel for electric installation
Trained personnel	Delegated task	Personnel trained by the operator-owner who know the task delegated to them and the possible dangers arising through improper behaviour.







Tab. 1: Target groups

1.4 Symbols









1.4.1 Danger levels

	Signal word	Danger level	Consequences of non-observance
	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
	ATTENTION	Potentially dangerous situation	Material damage

1.4.2 Danger signs

	Meaning	Source and possible consequences of non-observance
	Electrical voltage	Electrical voltage causes serious physical injury or death.
	Raised load	Falling objects can result in serious physical injury or death.
	Heavy load	Heavy loads can result in serious back problems.
	Risk of slipping	Discharging pumped liquid and oils on the foundation or tread surfaces can cause falls with serious physical injury or death.
	Flammable substances	Discharging pumped liquid and oils can be easily inflammable and can result in serious burns.
	Hot surface	Hot surfaces can cause burns.

1.4.3 Symbols in this document

	Meaning
	Warning personal injury
	Safety instruction
	Request for action
1. 	Multi-step instructions for actions
2. 	
3. 	
	Action result
	Cross-reference







2 Safety

2.1 Proper use

1.4.4 Symbols for personal protective equipment

Additional dangers arise for personnel without personal protective equipment. It is imperative that the personal protective equipment be worn.

Information on the personal protective equipment is provided separately at the beginning of the individual chapters in these instructions. The following table provides an overview.

	Meaning	Possible consequences of non-observance
	Protective helmet	Serious head injury through falling or toppling parts
	Protective goggles	Eye injury through hot, poisonous or corrosive liquids
	Hearing protection	Damage to hearing through loud noises
	Heat-resistant protective gloves with arm protection	Serious burns or cuts
	Close fitting work clothing	Serious physical injury through clothes being drawn in
	Slip resistant safety boots	Serious foot injury through falling or toppling parts and serious physical injury through falling

2 Safety

2.1 Proper use

- ☐ Use the pump station solely for transporting lubricating liquids that are chemically neutral and that do not contain gas or solid components.
- ☐ Use the pump station only within the operating limits specified on the rating plate and in the chapter "Technical data". In the case of operating data that do not agree with the specifications on the rating plate, please contact the manufacturer.
- ☐ The pump station is designed specially for the operating pressure named by the customer. If the actual operating pressure deviates notably from this design pressure, damage to the pump station 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 may the minimum pressure lie below 2 bar. In case of any doubt, please contact the manufacturer.

2.2 Foreseeable misuse

- ☐ Any use that extends beyond the proper use or any other use is misuse.
- ☐ The product is not suitable for pumping liquids outside the operational limits.
- ☐ Any bypassing or deactivation of safety equipment during operation is prohibited.

2.3 Obligations of the operator-owner

The operator-owner is the person who operates the product commercially or permits a third party to use it and who bears the legal responsibility for the product, the protection of the personnel and third parties during its operation.

The product is used in industrial applications. The operator-owner is therefore subject to the statutory obligations concerning occupational health and safety.

In addition to the safety instructions in these instructions, the regulations on safety, accident prevention and environmental protection respectively valid for the range of application of the product are to be observed.

2.4 Safety instructions

2.4.1 Fundamental safety instructions



The following safety instructions must be observed strictly:

- ☐ Read these operating instructions carefully and observe them.
- ☐ Read the operating instructions of the components carefully and observe them.
- ☐ Have work only carried out by qualified personnel/trained personnel.
- ☐ Wear personal protective equipment and work carefully.
- ☐ Pumped liquids can be subject to high pressure and can result in personal injury and damage to property in case of incorrect operation or damaged components.
- ☐ Pumped liquids can be hot, poisonous, combustible and caustic. Use corresponding protective equipment.
- ☐ Observe the associated data sheets and safety regulations when handling dangerous materials.
- ☐ Avoid skin contact with system parts carrying liquids at operating temperatures exceeding 60 °C.
- ☐ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations. Neutralize residues.
- ☐ Keep the mounting surfaces, scaffolding, ladders, lifting platforms and tools clean in order to prevent slipping or stumbling.
- ☐ If pressurized or energized components are damaged, shut down the pump station immediately. Replace the components.

3 Identification

3.1 Type code

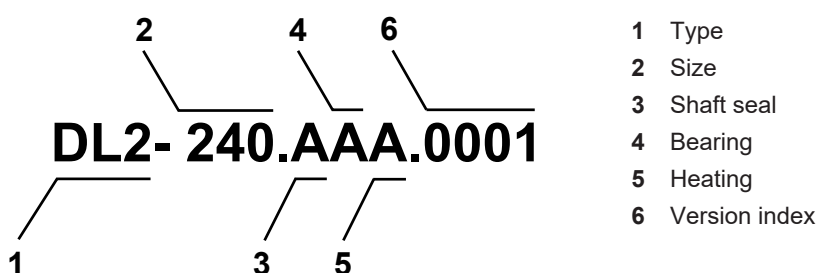


Fig. 1: Type code

Item	Classification	Description
1	Type	DL2 <input type="checkbox"/> Station with pumps of the FE series <input type="checkbox"/> Station with pumps of the NE series
2	Size	Corresponds to the delivery rate in [l/h] at rated speed
	Shaft seal	A Standard radial shaft seal
		B Standard mechanical seal
		C Mechanical seal of hard material
4	Bearing	A Inner bearing
5	Heating	A Without heating
6	Version index	For internal administration

Tab. 2: Type code

3.2 Rating plate

3.2 Rating plate

6	KRAL	CE	7
5	Art.-Nr. Item no.		
4	Typ Type	Δp	bar
3	SN Serial no.	Q	l/min
2	Tmin. / Tmax.	°C	n min ⁻¹
1	ps max. / pD max.	bar	v mm ³ /s
	Jahr Year	Gewicht Weight	kg

KRAL GmbH, 6890 Lustenau, Austria www.kral.at

Fig. 2: Rating plate

- 1 Construction year
- 2 Max. allowable working pressure suction-side/Max. allowable working pressure pressure-side
- 3 Temperature range
- 4 Serial number
- 5 Type
- 6 Article number
- 7 Differential pressure
- 8 Nominal delivery rate
- 9 Rated speed
- 10 Nominal viscosity
- 11 Weight

4 Technical data

4.1 Operating limits

In addition to the operating limits of the pump station, the operating limits of the attached pumps must also be observed.

Parameter	Unit	Size							
		150	240	320	400	500	750	1000	1300
Max. operating pressure	[bar]	6.0							
Max. inlet pressure									
<input type="checkbox"/> Mechanical seal	[bar]	5.0							
<input type="checkbox"/> Radial shaft seal	[bar]	0.5							
Max. temperature of pumped liquid	[°C]	80							
Viscosity min. – max.	[mm²/s]	2 – 37							
Min. – max. ambient temperature	[°C]	-20 ... 50							

Tab. 3: Pump station operating limits

4.2 Filling volume

Parameter	Unit	Size
		150 240 320 400 500 750 1000 1300
Filling volume of station block [l]		Approx. 1.0

Tab. 4: Filling volume of station block

4.3 Sound pressure level

Guide value at 1 m distance, rated speed of the station, 50 Hz operation

	Size							
	150	240	320	400	500	750	1000	1300
	Max. sound pressure level ±3 [dB(A)]							
Pump	44.8	46.1	47.7	47.8	49.0	50.4	51.8	53.6
Motor	45.0	45.0	45.0	44.0	44.0	54.0	54.0	54.0
1 pump unit (lever position left/ right)	47.9	48.6	49.6	49.3	50.2	55.6	56.0	56.8
2 pump units (middle position)	49.6	50.5	51.7	51.6	52.6	56.7	57.4	58.5

Tab. 5: Sound pressure level

4.4 Weights

The weight is specified on the rating plate.

5 Function description

5.1 Structure

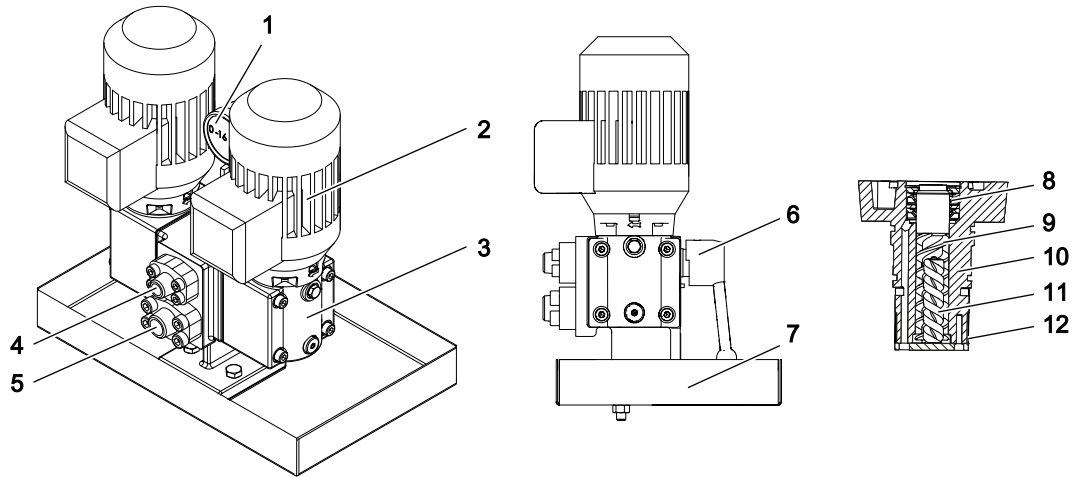


Fig. 3: Structure of pump station

- | | | | |
|---|---|----|--------------------------------|
| 1 | Pressure-side pressure gauge | 7 | Oil pan |
| 2 | Motor | 8 | Shaft seal (radial shaft seal) |
| 3 | Station block | 9 | Shaft end pump (main screw) |
| 4 | Pressure-side connection | 10 | Cartridge housing |
| 5 | Suction-side connection | 11 | Idle screw |
| 6 | Reversing valve with integrated over-flow valve | 12 | Strainer |

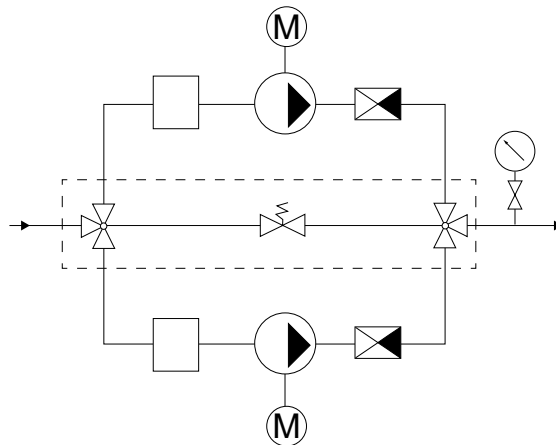


Fig. 4: Hydraulic scheme

5.2 Functional principle

Pump stations of the DL2 series with two KRAL screw pumps of the series FE or NE are suitable for pumping light oil.

Screw pumps are rotating pumps. Their displacement effect results from three rotating screws **9** and **11** and the enclosing cartridge housing **10**. Radial support of the screw set is effected through the sliding contact in the cartridge housing that depends on lubrication by the pumped liquid. Screw pumps are therefore not suitable for dry running and can only be used up to specific pressure limits and viscosity limits. Due to the narrow gap dimensions pumping of suspended solids is not possible. The shaft seal **8** seals the main screw at the outlet of the housing. The sealing chamber is connected with the suction chamber via a relief line.

The pump station is connected with the pipe system via the connections **4** and **5**. Depending on the position of the reversing valve **6** the pumped liquid flows through the left, right or both pumps.

The oil pan collects leaks from the pump station.

5.3 Overflow valve

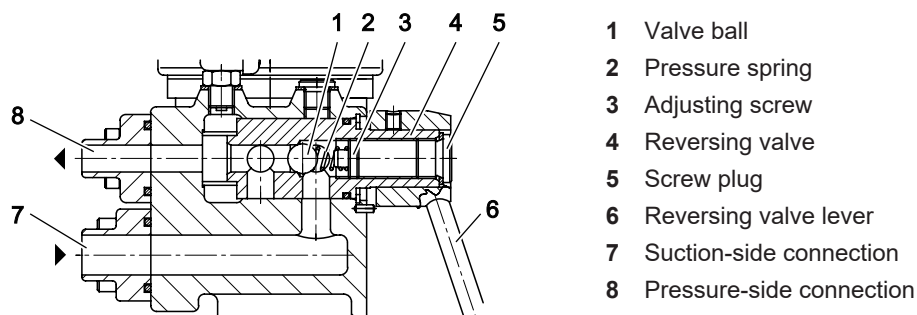


Fig. 5: Overflow valve

The overflow valve is integrated in the control block and ensures that very high pressures that could result in housing parts bursting do not arise.

The overflow valve is purely there as a safety element for the pumps and should not be used for control or regulation purposes 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 overflow valve and the valve seating to become damaged. As a result, the overflow 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 results in excess heating of the pump. This reduces viscosity and can ultimately lead to pump failure.

It therefore has to be ensured at the system by a safety valve that the maximum allowable working pressure always lies under the opening pressure of the overflow valve.

Note The opening pressure of the overflow valve is set to 110% of the differential pressure in the factory.

The overflow valve is accessible through a screw plug **5** and can be adjusted from the outside ↗ During operation, Page 21.

Note ☐ A function test of the overflow valve at least every 5 years is essential for the safe operation ↗ During operation, Page 21.

☐ Scope and if necessary shorter test intervals must be specified by the operator-owner in accordance with the requirements and national provisions (for example Austrian Ordinance of Safety and Health (BetrSichV)).

☐ The first function test must take place directly after the commissioning.

☐ After longer downtimes (> 4 weeks) the function of the overflow valve must be tested again.

5.4 Pressure measurement

A pressure gauge **5** is mounted in the centre of the station in order to monitor the supply pressure. The pressure gauge is always connected to the pressure side of the station and is thus independent of the position of the reversing valve **6**.

The shut-off valves at the pressure gauges may only be opened to read the pressure values, ↗ During operation, Page 21.

6 Transportation, storage

6.1 Dangers during transportation



The following safety instructions must be observed:

- ☐ Have all work only carried out by authorized transport personnel.
- ☐ Use intact and correctly dimensioned hoisting equipment.
- ☐ Ensure that the means of transport is in a flawless state.
- ☐ Ensure that the centre of gravity of the load is taken into consideration.
- ☐ Do not stand under raised loads.

6.2 Dangers during storage



The following safety instructions must be observed:

- ☐ Observe the storage conditions.

6.3 Unpacking and checking the state of delivery

1. ➤ Upon delivery unpack the pump station and check it for damage during transportation.
2. ➤ Report damage during transportation immediately to the manufacturer.
3. ➤ Dispose of packaging material in accordance with the locally applicable regulations.

6.4 Transporting the pump station

Personnel qualification:	<input type="checkbox"/> Transport personnel
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective helmet <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Mobile crane, forklift, hoisting equipment



WARNING

Risk of injury and damage to equipment through falling and toppling parts.

- ▶ Use intact and correctly dimensioned hoisting equipment in accordance with the total weight to be transported.
- ▶ Select the lift points for the hoisting equipment in accordance with the centre of gravity and the weight distribution.
- ▶ Use at least two load ropes.
- ▶ Do not stand under raised loads.

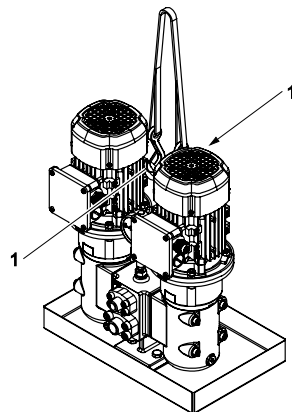


Fig. 6: Fastening of hoisting equipment

1. ➤ Screw in eye bolt 1 at both motors. Position see figure.
2. ➤ Secure the hoisting equipment to the eye bolts of the pump station and lift the pump station using the crane.

7 Preservation

6.5 Storing the pump station

6.5 Storing the pump station

During the test run, the internal components of the pump station are wetted with test oil, which has a preservative effect. The pipe connections are fitted with protective covers. Unless otherwise specified, the outer parts of the pump station are preserved with a single-coat PU-based two-component paint. The preservative applied at the factory will protect the pump station 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 station is additionally packed in hermetically sealing anti-corrosion paper.

Personnel qualification:	<input type="checkbox"/> Transport personnel
Aids:	<input type="checkbox"/> Mobile crane, forklift, hoisting equipment

ATTENTION

Damage to equipment and corrosion if stored improperly and during longer standstills.

- ▶ Protect the pump station against damage, heat, sunlight, dust, moisture and magnetic fields.
- ▶ Protect against corrosion during longer standstill.
- ▶ Observe measures for storing and preservation.

1. ➤ Store cool and dry and protect against sunlight.
2. ➤ Ensure that the anti-corrosion paper is not damaged.
3. ➤ Observe the intervals for preservation ➤ Preservation, Page 12.

7 Preservation

7.1 Preservation table

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

Type of delivery	Condition
Standard delivery	<input type="checkbox"/> Storage time exceeding six weeks <input type="checkbox"/> Unfavourable storage conditions such as high humidity, salty air, etc.
Delivery with long-term preservation	<input type="checkbox"/> Opened or damaged packaging

Tab. 6: Conditions for additional preservation

7.2 Preserving the inner surfaces

Personnel qualification:	<input type="checkbox"/> Trained personnel
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Castrol Rustilo DWX 21 or other preservative offering comparable protection

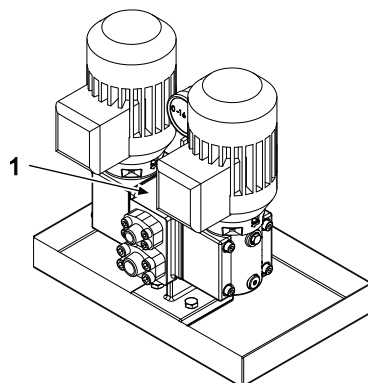


Fig. 7: Preserving the inner surface

1. ➤ Open the screw plug 1.
2. ➤ Pour the preservative into the station block until it reaches approx. 2 cm under the rim, while slowly turning the fan impeller of the motor in the direction of rotation at the pumps.
3. ➤ Close the screw plug.
4. ➤ After about six months storage check the filling level of the oil and if necessary top up.

7.3 Preserving the outer surfaces

Personnel qualification:	<input type="checkbox"/> Trained personnel
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Face protection <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Calcium complex grease (for example TEVI-ER® GREASE WAVE 100 with adhesive additive) <input type="checkbox"/> Castrol Rustilo DWX 21 or other preservative offering comparable protection

1. ➤ Brush calcium complex grease corrosion protection (for example TEVIER® FETT WAVE 100 with adhesive additive) to the mounting surfaces.
2. ➤ Brush or spray preservative (for example Castrol Rustilo DWX 21) onto the process connections and remaining plain and unpainted parts.
3. ➤ At intervals of about six months check the preservation and if necessary repeat.

7.4 Removing the preservation

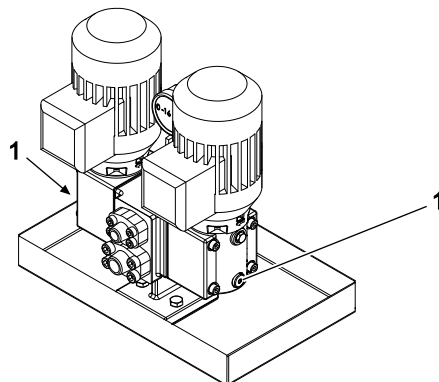
Personnel qualification:	<input type="checkbox"/> Trained personnel
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Solvent <input type="checkbox"/> Steam-jet cleaning device with wax-dissolving additives <input type="checkbox"/> Collection tank



CAUTION

Risk of injury through discharging preservative.

- ▶ Wear personal protective equipment during all the work.
- ▶ Collect any discharging preservative safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.



1. ➤ Clean the outside of the pump station with solvents, if necessary using a steam-jet cleaning device.
2. ➤ Remove the screw plug 1 carefully in order to reduce any pressure that may exist in the pump station.

8 Installation, removal

8.1 Dangers during installation

3. ➤ Drain the pump station, collecting the preservative in a collection tank.
4. ➤ To remove the residual preservative, flush the pump station with the pumped liquid.

8 Installation, removal

8.1 Dangers during installation



The following safety instructions must be observed strictly:

- ☐ Have all work carried out only by authorized qualified personnel.
- ☐ Before installation ensure that the operating limits, NPSH values and ambient conditions are observed.
- ☐ Observe the tightening torques ↗ Appendix, Page 44.
- ☐ Ensure that all the components can be accessed and that maintenance work can be carried out easily.

8.2 Dangers during removal



The following safety instructions must be observed strictly:

- ☐ Have all work carried out only by authorized qualified personnel.
- ☐ Before beginning work, let the pump station cool down to the ambient temperature.
- ☐ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.
- ☐ Ensure that the collection tank for discharging pumped liquids is sufficiently large.

8.3 Mounting the pump station

The pump station is operated in a vertical installation position.

Note Soiling in the pipe system impairs the service life of the pump station. If the pipe system is flushed using the pump station during the initial commissioning, an additional commissioning filter has to be installed temporarily before the pump station. Alternatively the strainers supplied as standard can be replaced during commissioning by fine-meshed commissioning strainers.

Personnel qualification:	<input type="checkbox"/> Transport personnel <input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Mobile crane, forklift, hoisting equipment



WARNING

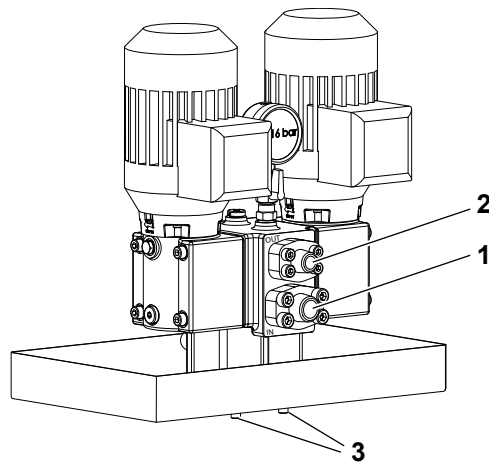
Risk of injury and damage to equipment through falling and toppling parts.

- ▶ Only fasten the pump station on a stable bearing underground.
- ▶ Ensure that fastening elements and pipings are fastened sufficiently.

ATTENTION

Damage to device through impurity 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 station.
- ▶ Ensure that a commissioning filter is installed when the pipe system is flushed and cleaned using the pump.



- 1 Suction-side connection
- 2 Pressure-side connection
- 3 Fastening element

Fig. 8: Mounting the pump station

Requirement:

- ✓ Pump station connections protected against soiling, for example by using the protective cover mounted in the factory
- 1. ➤ Bring the pump station into the installation position. Take the flow direction into consideration.
- 2. ➤ Fasten the pump station with fastening elements **3** securely on the underground.
- 3. ➤ After the connecting work clean the pipe system thoroughly ➤ Commissioning, Page 18.

8.4 Removing the pump station

Personnel qualification:	<input type="checkbox"/> Transport personnel <input type="checkbox"/> Fitter <input type="checkbox"/> Electrician
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective helmet <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Mobile crane, forklift, hoisting equipment <input type="checkbox"/> Collection tank



⚠ DANGER

Risk of death resulting from electric shock.

- ▶ Ensure that the electrical power supply is de-energized and is secured against being switched back on.
- ▶ Observe the operating instructions of the electrical components.



⚠ DANGER

Risk of death resulting from falling load.

- ▶ Use intact and correctly dimensioned hoisting equipment.
- ▶ Ensure that the crane and hoisting equipment are in a flawless state.
- ▶ Do not stand under raised loads.
- ▶ Take the centre of gravity into account and secure the load against tilting.
- ▶ A crane operator and transport personnel are required for transportation (2 persons).

9 Connection

9.1 Dangers during connection work



DANGER

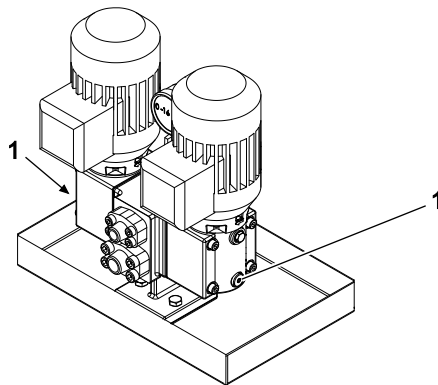
Risk of death through emitted pumped liquid.

Pumped liquids can be hot, poisonous, combustible and caustic and can spray out under high pressure.

- ▶ Wear personal protective clothing during all the work. Ensure face protection.
- ▶ Before beginning work, let the pump station cool down to the ambient temperature.
- ▶ Ensure that the pump station is depressurized.
- ▶ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.

Requirement:

- ✓ Pump station and pumped liquid cooled down to the ambient temperature
- 1. ▶ Ensure that the pump station is deenergized and is secured against being switched back on.
- 2. ▶ Ensure that the pump station is depressurized.
- 3. ▶ Close the pressure-side and suction-side shut-off devices.
- 4. ▶ Loosen the connecting screws of the suction connection and the pressure connection. Collect any discharging pumped liquid.
- 5. ▶ After the pumped liquid has been drained completely, dismantle the pressure-side and suction-side connecting flange.



- 6. ▶ Open the screw plugs **1**, collect any discharging pumped liquid.
- 7. ▶ Remove the pump station.

9 Connection

9.1 Dangers during connection work



The following safety instructions must be observed strictly:

- ☐ Have all work on the pump station and pipe system only carried out by authorized qualified personnel.
- ☐ Ensure that impurities cannot get into the pump station and pipe system.
- ☐ Ensure that mechanical connections are mounted stress-free.
- ☐ Observe the tightening torques.
- ☐ Have all the work on the electrical equipment only carried out by electricians.
- ☐ Before commissioning ensure correct earthing, equipotential bonding and overcurrent protection.
- ☐ Before beginning work on the pump station ensure that the electrical power supply is deenergized and is secured against being switched back on.
- ☐ If the insulation of the electrical cables or wires is damaged, disconnect the power supply immediately.

9.2 Connecting the pump station to the pipe system

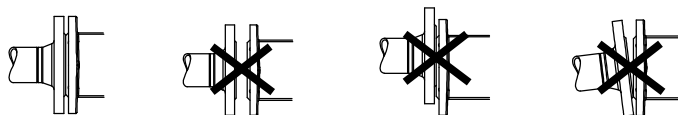


Fig. 9: Connecting the piping

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Protective helmet <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Mobile crane, forklift, hoisting equipment <input type="checkbox"/> Torque wrench

ATTENTION

Damage to device through impurity 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 station.
- ▶ Ensure that a commissioning filter is installed when the pipe system is flushed and cleaned using the pump.

ATTENTION

Damage to device through mechanical stress.

- ▶ Ensure that the pump station is mounted free of mechanical stresses in the pipe system.
- ▶ Observe the tightening torques.

1. ➤ Check whether the reversing valve or the two-way valve moves easily.
If the levers of the valves cannot be turned by hand, remedy the fault before commissioning the pump station.
2. ➤ Attach protective covers in front of the connecting flanges before welding work.
3. ➤ Place the piping in position and support the weight of the piping. Do not use the pump station as a support for connected piping.
4. ➤ Install compensating elements if temperature-related material expansion is possible.
5. ➤ Check the linear, height and angular offset and correct if necessary.
⇒ If the screws tighten easily, this is a sure sign that the installation is stress-free.
6. ➤ Tighten the connecting screws.

9.3 Connecting the pump station to the power supply

Personnel qualification:	<input type="checkbox"/> Electrician
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots

10 Operation

10.1 Dangers during operation



DANGER

Risk of death resulting from electric shock.

- ▶ Ensure that the electrical power supply is de-energized and is secured against being switched back on.
- ▶ Before commissioning ensure correct grounding and equipotential bonding.
- ▶ Observe the operating instructions of the electrical components.

1. ▶ Carefully earth the base frames with the screwing.
2. ▶ Connect the electrical components of the pump station in accordance with the corresponding operating instructions.
3. ▶ When connecting the pump station to the complete system continue equipotential bonding.

10 Operation

10.1 Dangers during operation



The following safety instructions must be observed strictly:

- ☐ Have all work carried out only by authorized qualified personnel.
- ☐ Before commissioning ensure that a safety valve has been installed in the pressure-side pipe system to protect the pump station.
- ☐ Before commissioning, make sure that the suction line and pump station are filled.
- ☐ Pumped liquids can be hot, poisonous, combustible and caustic. Use corresponding protective equipment.
- ☐ Observe the operating instructions of the pump and the further components.
- ☐ Ensure that the pump station is only operated within the operating limits.
- ☐ Ensure that during cooling down or heating up the pump station is only subjected to slow temperature changes.
- ☐ Ensure that existing safety equipment is not bypassed or activated during operation.
- ☐ Before decommissioning ensure that the electrical power supply is deenergized and is secured against being switched back on.

10.2 Commissioning

10.2.1 Cleaning the pipe system

Note Soiling in the pipe system impairs the service life of the pump station. If the pipe system is flushed using the pump station during the initial commissioning, an additional commissioning filter has to be installed temporarily before the pump station. Alternatively the strainers supplied as standard can be replaced during commissioning by fine-meshed commissioning strainers.

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Protective helmet <input type="checkbox"/> Safety boots

ATTENTION

Damage to device through impurity 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 station.
- ▶ Ensure that a commissioning filter is installed when the pipe system is flushed and cleaned using the pump.

ATTENTION

Damage to equipment through additional pressure loss in the commissioning filter/commissioning strainer.

- ▶ Calculate the flow resistance and determine the remaining pump intake.
- ▶ Monitor the suction-side pressure.
- ▶ Check the commissioning filter/commissioning strainer regularly.

Requirement:

✓ If required, commissioning filter/commissioning strainer installed (mesh width 0.02 mm)

1. ▶ Clean the complete pipe system before commissioning in order to protect the pump station.
2. ▶ Flush the pipe system at least 50 – 100 hours.

10.2.2 Filling and venting the pump

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective helmet <input type="checkbox"/> Face protection <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots

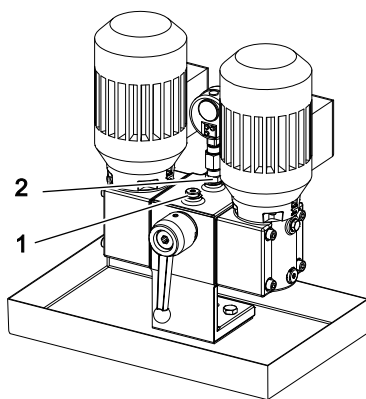


WARNING

Risk of injury through emitted pumped liquid.

Pumped liquids can be hot, poisonous, combustible and caustic.

- ▶ Wear personal protective clothing during all the work. Ensure face protection.
- ▶ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.



Requirement:

- ✓ Shut-off devices of the suction line and pressure line closed
- ✓ Lever of the reversing valve to middle position

1. ▶ Remove the screw plug 1.
2. ▶ Open the screwing of the pressure gauge 2 by a max. of two rotations so that air can escape during the filling process.
3. ▶ Fill the pump via the hole 1 until pumped liquid is emitted at the pressure gauge, rotate the fan impeller of the motor in the process.
4. ▶ Tighten the screw plug and screwing of the pressure gauge again with torque, ↗ Appendix, Page 44.

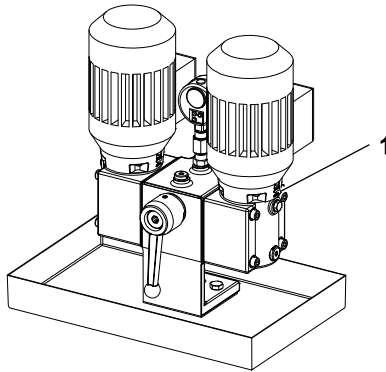
10.2.3 Checking the direction of rotation

The direction of rotation of the pumps is indicated by an arrow on the pump. The direction of rotation of the motor specifies the direction of rotation of the pump. The fan impeller of the motor must rotate in the same direction in which the arrow for the direction of rotation on the pump points.

Note Standard direction of rotation: clockwise (viewed from the motor)

Personnel qualification:	<input type="checkbox"/> Fitter
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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 the direction of rotation 1.
3. ➔ If the directions do not match, swap the two electrical connection phases. Repeat Steps 1 and 2.
4. ➔ Repeat Steps 1 to 3 for the second pump.

10.2.4 Commissioning the pump station

Personnel qualification:	<input type="checkbox"/> Fitter <input type="checkbox"/> Electrician
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective helmet <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots <input type="checkbox"/> Face protection
Aids:	<input type="checkbox"/> Collection tank



WARNING

Risk of injury through emitted pumped liquid.

Pumped liquids can be hot, poisonous, combustible and caustic.

- ▶ Wear personal protective clothing during all the work. Ensure face protection.
- ▶ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.

ATTENTION

Dry running can damage pump equipment.

- ▶ Ensure that the pump and the connected pipe system are filled properly.
- ▶ If the pump does not deliver after 10 – 15 seconds, abort commissioning.

Requirement:

- ✓ Pump station set up and connected correctly
- ✓ Motors connected correctly
- ✓ Pipe system is free of impurities
- ✓ Pump station filled
- ✓ Shut-off devices in the suction line and pressure line opened
- ✓ All connections are sealed

1. ➤ Switch on the pump station.
⇒ The pump station delivers when the pressure on the pressure side of the pump station rises.
2. ➤ If the pump station does not deliver after 10–15 seconds of operation, abort commissioning, eliminate the cause of the fault and only then continue the commissioning procedure. Take the information from the fault table into account, ↪ Troubleshooting, Page 37.
3. ➤ Run the pump station for a few minutes to allow the pipe system to vent fully.
⇒ The pipe system is fully vented when the pump operating noise is smooth and a pressure gauge on the pressure side shows no more fluctuations.
4. ➤ Checking overflow valve functions ↪ During operation, Page 21.

10.3 During operation

10.3.1 Checking the operating pressure

Personnel qualification:	<input type="checkbox"/> Trained personnel
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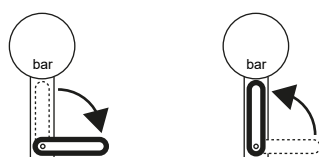


Fig. 10: Pressure gauge shut-off valves closed/open - principle diagram

ATTENTION

Leak in the pressure gauge through permanently opened pressure gauge shut-off valve.

- Close the pressure gauge shut-off valve immediately after completing reading.

1. ➤ Open the pressure gauge shut-off valve.
2. ➤ Read the operating pressure and close the pressure gauge shut-off valve.

10.3.2 Activating the reversing valve

Personnel qualification:	<input type="checkbox"/> Trained personnel
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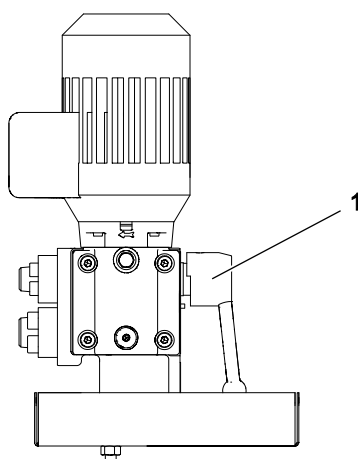


Fig. 11: Reversing valve lever

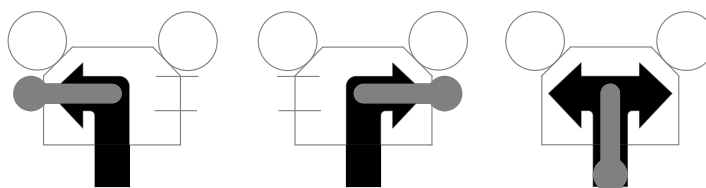


Fig. 12: Positions of the reversing valve

Note The reversing valve can be operated during operation.

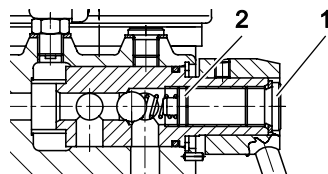
1. ➤ Turn the lever **1** to the left.
⇒ Left-hand pump is connected to the pipe system.
2. ➤ Turn the lever **1** to the right.
⇒ Right-hand pump is connected to the pipe system.
3. ➤ Turn the lever **1** into the middle position.
⇒ Both pumps are connected with the pipe system.

Note The reversing valve seals mechanically and therefore has a low amount of leakage.

10.3.3 Adjusting the overflow valve

Personnel qualification:	<input type="checkbox"/> Fitter
Aids:	<input type="checkbox"/> Allen key

Note The opening pressure of the overflow valve is set to 110% of the differential pressure in the factory.



- 1 Screw plug
- 2 Adjusting screw

Fig. 13: Adjusting the overflow valve



WARNING

Risk of injury through emitted pumped liquid.

Pumped liquids can be hot, poisonous, combustible and caustic.

- ▶ Wear personal protective clothing during all the work. Ensure face protection.
- ▶ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.

Requirement:

- ✓ Pressure-side pressure gauge installed

1. ➤ Switch on the pump and remove the screw plug **1** of the overflow valve.
2. ➤ Increase the supply pressure step-by-step to check the opening pressure of the overflow valve.
Keep an eye on the pressure gauge and make sure that the operating limits are observed.
⇒ The opening pressure is reached, when the displayed pressure falls.
3. ➤ Turn the adjusting screw **2** to set the opening pressure:
Turning clockwise: Increase the opening pressure
Turning counter-clockwise: Reduce the opening pressure
4. ➤ Repeat Steps 2 and 3 until the desired opening pressure is reached.
5. ➤ Tighten the screw plug **1** again.

10.3.4 Test the overflow valve

Personnel qualification:	<input type="checkbox"/> Trained personnel
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Face protection <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots



WARNING

Risk of injury through emitted pumped liquid.

Pumped liquids can be hot, poisonous, combustible and caustic.

- ▶ Wear personal protective clothing during all the work. Ensure face protection.
- ▶ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.

Requirement:

- ✓ Function test necessary ↗ Maintenance, Page 25
- ✓ Pressure-side pressure gauge installed

1. ➤ Switch on the pump unit.
2. ➤ Gradually increase the delivery pressure downstream of the pump using a valve/ball valve etc. Keep an eye on the pressure gauge and make sure that the operating limits are observed.
 - ⇒ The response pressure of the overflow valve is reached as soon as the displayed pressure drops briefly.
 - ⇒ Flow noises change.
 - ⇒ Overflow valve opens and closes at short intervals.
3. ➤ Close the valve/ball valve downstream of the pump completely.
 - ⇒ 100% of the delivery volume now circulates via the overflow valve.
4. ➤ Keep an eye on the pressure gauge and make sure that the operating limits are observed.
5. ➤ Maintain the operating state for a maximum of 30 s.
6. ➤ Open the valve/ball valve completely again after the pump.
7. ➤ Switch off the pump unit.

10.3.5 Switching off the pump station

Personnel qualification:	<input type="checkbox"/> Trained personnel
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ATTENTION

Seal damage through pressurizing during standstill.

- ▶ Ensure that the maximum permissible system pressure is not exceeded.

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

10.4 Decommissioning

10.4.1 Taking the pump station out of operation

Personnel qualification:	<input type="checkbox"/> Fitter <input type="checkbox"/> Electrician
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots <input type="checkbox"/> Face protection
Aids:	<input type="checkbox"/> Collection tank



WARNING

Risk of injury through emitted pumped liquid.

Pumped liquids can be hot, poisonous, combustible and caustic.

- ▶ Wear personal protective clothing during all the work. Ensure face protection.
- ▶ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.

—▶ Carry out the following measures during operation interruptions.

Scope of the operation interruption	Measure
<input type="checkbox"/> Pump station shut down for longer period	—▶ Depending on the pumped liquid
<input type="checkbox"/> Pump station drained	—▶ Close the pressure- and suction-side shut-off devices.
<input type="checkbox"/> Pump station dismantled	—▶ Disconnect the motors from the power supply and secure against being switched back on.
<input type="checkbox"/> Pump station stored	—▶ Observe measures for storing and preservation ↳ Transportation, storage, Page 11.

Tab. 7: Measures during operation interruptions

Behaviour of the pumped liquid	Duration of the operation interruption	
	Short	Long
<input type="checkbox"/> Solids sediment	—▶ Flush the pump station.	—▶ Flush the pump station.
<input type="checkbox"/> Congealed/frozen <input type="checkbox"/> No corrosive burden	—▶ Heat or drain the pump station.	—▶ Drain the pump station.
<input type="checkbox"/> Congealed/frozen <input type="checkbox"/> Corrosive burden	—▶ Heat or drain the pump station.	1. —▶ Drain the pump station. 2. —▶ Preserve the pump station.
<input type="checkbox"/> Remains liquid <input type="checkbox"/> No corrosive burden	—	—
<input type="checkbox"/> Remains liquid <input type="checkbox"/> Corrosive burden	—	1. —▶ Drain the pump station. 2. —▶ Preserve the pump station.

Tab. 8: Measures depending on the behaviour of the pumped liquid

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

10.5 Recommissioning

10.5.1 Recommissioning the pump station

—▶ Carry out all the steps as for the commissioning process, ↳ Commissioning, Page 18.

11 Maintenance

11.1 Dangers during maintenance



The following safety instructions must be observed strictly:

- ☐ Have all work carried out only by authorized qualified personnel.
- ☐ Before beginning work, let the pump station cool down slowly to the ambient temperature. Avoid rapid temperature changes.
- ☐ Pumped liquids can be hot, poisonous, combustible and caustic. Use corresponding protective equipment.
- ☐ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.
- ☐ Ensure that the collection tank for discharging pumped liquids is sufficiently large.
- ☐ Observe the operating instructions and data sheets of the components.

11.2 Required maintenance

The service life depends on the observance of the operating conditions of the pump station and the requirements from the operating instructions of the components.

Component	Required maintenance	Cycle
Pump station	<input type="checkbox"/> Visual inspection <input type="checkbox"/> Acoustic inspection	4 weeks
Pump station (reversing valve)	<input type="checkbox"/> Change of the active pump line	4 weeks
Leakage vent hole	<input type="checkbox"/> Visual inspection <input type="checkbox"/> If required, clean	4 weeks
Strainer	<input type="checkbox"/> Visual inspection <input type="checkbox"/> If required, clean	4 weeks
Overflow valve	<input type="checkbox"/> ↗ Operation, Page 18 functional test	≤ 5 years

Tab. 9: Required maintenance

11.3 Ball bearing (inner bearing)

The ball bearings used are lubricated by the pumped liquid. Maintenance is therefore not required. The manufacturer recommends renewing the ball bearings every 20,000 operating hours. When using the pump in lubrication oil applications a bearings replacement at the latest after 5 years (40000 h) is sufficient.

11.4 Maintaining the pump station

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots

1. ➤ Change the active pump line every four weeks by means of the reversing valve in order to ensure a uniform distribution of the operating hours.
2. ➤ Check the pump station visually and acoustically every four weeks.
3. ➤ If there are signs of wear, eliminate the cause ↗ Servicing, Page 26.
4. ➤ Observe the additional operating instructions of optional components.

12 Servicing

11.5 Cleaning the leakage vent hole

11.5 Cleaning the leakage vent hole

The regular small amounts of leakage can result in deposits that can prevent free draining of further leakage liquids after a longer operating period.

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Face protection <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots

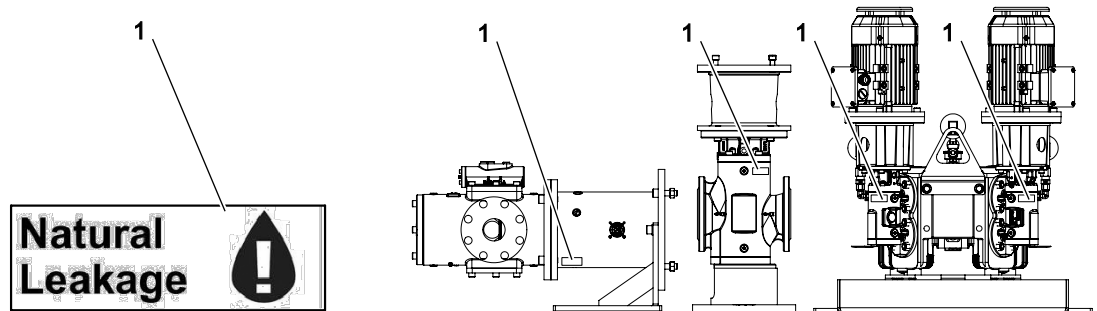


Fig. 14: Leakage hole - schematic diagrams

Note The leakage hole on the pump/pump station is marked with a sign 1.

1. ➤ If a leakage vent line is connected, unscrew the leakage vent line.
2. ➤ To check the continuity of the leakage hole insert a flexible soft mandrel into the leakage hole.
3. ➤ If there is insufficient continuity, clean the leakage hole. If there is sufficient continuity, clean the leakage pipe.
4. ➤ If existing, reconnect the leakage vent line again.

12 Servicing

12.1 Dangers during servicing



The following safety instructions must be observed strictly:

- ☐ Have all work carried out only by authorized qualified personnel.
- ☐ Before beginning work on the pump station ensure that the electrical power supply is deenergized and is secured against being switched back on.
- ☐ Before beginning work, let the pump station cool down slowly to the ambient temperature. Avoid rapid temperature changes.
- ☐ Pumped liquids can be hot, poisonous, combustible and caustic. Use corresponding protective equipment.
- ☐ Ensure that the pump station is depressurized and that shut-off devices are not operated uncontrolled.
- ☐ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.
- ☐ Ensure that the collection tank for discharging pumped liquids is sufficiently large.
- ☐ Observe the tightening torques ➤ Appendix, Page 44.
- ☐ Observe the operating instructions and data sheets of the components.

12.2 Wear

12.2.1 Signs of wear

The following table lists signs of progressive wear of individual station elements:

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

Tab. 10: Signs of wear

12.2.2 Mechanical seal

Shaft seals are subject to natural wear that depends strongly on the respective conditions of use. General statements about the durability can therefore not be given.

In case of strong soiling with solidified or sticky leakage residues the manufacturer recommends that you dismantle the mechanical seal completely and clean it, together with the inner surfaces of the pump housing.

12.2.3 Radial shaft seal

Shaft seals are subject to natural wear that depends strongly on the respective conditions of use. General statements about the service life can therefore not be given.

12.3 Replacing the coupling

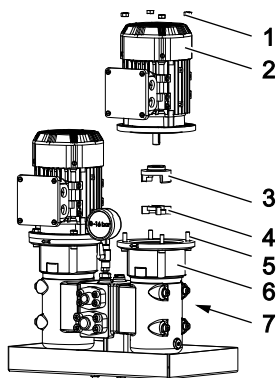
12.3.1 Removing the coupling

As of size 320 couplings are installed in the pump stations of the series DL2.

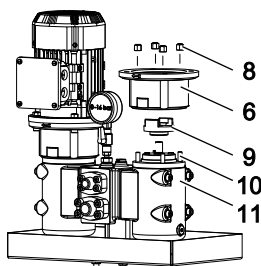
Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Extractor

Requirement:

- ✓ Pump unit disconnected from the electrical power supply, deenergized and secured against being switched back on



1. ➡ Switch over the lever of the reversing valve **7** in order to shut off the respective side ➡ During operation, Page 21.
2. ➡ Remove the hexagon nuts **1** and lift the motor **2** via stud screws **5** from the pump bracket **6**.
3. ➡ Remove the coupling intermediate ring **4** and pull off the motor-side coupling half **3** using an extractor.



4. ➔ Remove the hexagon nuts **8** between the pump bracket and housing **11** and remove the pump bracket via the stud screws **10**.
5. ➔ Pull off the pump-side coupling half **9** using an extractor.

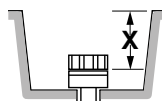
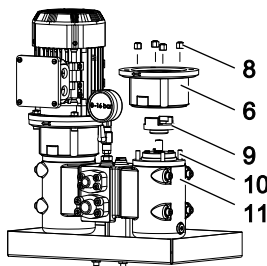
12.3.2 Installing the coupling

As of size 320 couplings are installed in the pump stations of the series DL2.

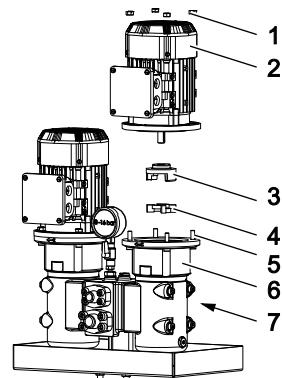
Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Measuring stick <input type="checkbox"/> Silicone oil

Note The coupling halves can be mounted more easily if they are heated to 80 °C – 100 °C.

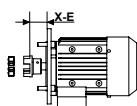
1. ➔ Oil the shaft of the pump with silicone oil.



2. ➔ Slide the pump-side coupling half **9** onto the shaft until it stops.
3. ➔ Place the pump bracket **6** via stud screws **10** on the housing **11** and tighten the hexagon nuts **8** with torque.
4. ➔ Measure and write down the distance **X** between the face of the coupling claws and the connecting surface of the pump bracket.



5. ➔ Insert the coupling intermediate ring **4** in the pump-side coupling half.
6. ➔ Tighten the motor-side coupling half **3** on the shaft end of the motor **2**.



7. ➔ 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-E.

8. ➤ Place the motor over stud screws **5** on the pump bracket.
9. ➤ Tighten the hexagon nuts **1** between the motor and pump bracket with torque.

12.4 Replacing the pump (DL2 to 240)

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Face protection <input type="checkbox"/> Protective gloves
Aids:	<input type="checkbox"/> Collection tank <input type="checkbox"/> Hoisting equipment



WARNING

Risk of injury through emitted pumped liquid.

Pumped liquids can be hot, poisonous, combustible and caustic.

- ▶ Wear personal protective clothing during all the work. Ensure face protection.
- ▶ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.
- ▶ If work on the blocked part of the pump station takes longer, monitor the filling level of the strainer housing and catch the leakage.



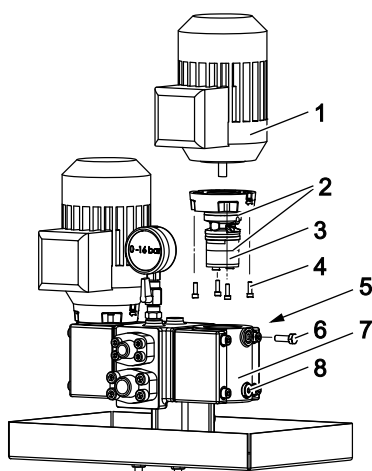
WARNING

Risk of injury through emitted pumped liquid when working on the pump station without previous pressure relief.

- ▶ Open the screw plug of the vent hole by a max. of 2 rotations in order to reduce the internal pressure in the housing.

Requirement:

- ✓ Pump unit disconnected from the electrical power supply, deenergized and secured against being switched back on



1. ➤ Switch over the lever of the reversing valve **5** in order to shut off the respective side ➤ During operation, Page 21.
2. ➤ Loosen the screw plug **8** carefully to slowly release the inner pressure in the housing **7**.
3. ➤ Remove the screw plug and collect the pumped liquid in a collection tank.
4. ➤ Remove the socket screw **6**.
5. ➤ Lift the cartridge pump **3** and motor **1** exactly vertically from the housing.
6. ➤ Remove the socket screws **4** between the motor and cartridge pump and remove the motor.
7. ➤ Mount the new cartridge pump with socket screws at the motor with torque.

12.5 Replacing the pump (DL2 from 320)

8. ➤ Carefully clean the sealing surfaces on and in the housing.
9. ➤ Insert the cartridge pump with motor exactly vertically into the outer housing. Ensure that the O-rings **2** are not damaged in the process.
10. ➤ Tighten the socket screw **6** with torque.
11. ➤ Filling and venting the pump ➤ Commissioning, Page 18.

12.5 Replacing the pump (DL2 from 320)

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Face protection <input type="checkbox"/> Protective gloves
Aids:	<input type="checkbox"/> Collection tank <input type="checkbox"/> Hoisting equipment



WARNING

Risk of injury through emitted pumped liquid.

Pumped liquids can be hot, poisonous, combustible and caustic.

- ▶ Wear personal protective clothing during all the work. Ensure face protection.
- ▶ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.
- ▶ If work on the blocked part of the pump station takes longer, monitor the filling level of the strainer housing and catch the leakage.



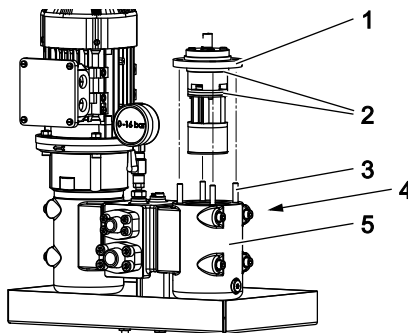
WARNING

Risk of injury through emitted pumped liquid when working on the pump station without previous pressure relief.

- ▶ Open the screw plug of the vent hole by a max. of 2 rotations in order to reduce the internal pressure in the housing.

Requirement:

- ✓ Pump unit disconnected from the electrical power supply, deenergized and secured against being switched back on
- ✓ Coupling removed



1. ➤ Switch over the lever of the reversing valve **4** in order to shut off the respective side ➤ During operation, Page 21.
2. ➤ Pull the cartridge housing **1** exactly vertically via the stud screws **3** from the housing **5**.
3. ➤ Carefully clean the sealing surfaces on and in the housing.
4. ➤ Insert the new cartridge pump exactly vertically via the stud screws into the housing. Ensure that the O-rings **2** are not damaged in the process.
5. ➤ Installing the coupling ➤ Servicing, Page 26.

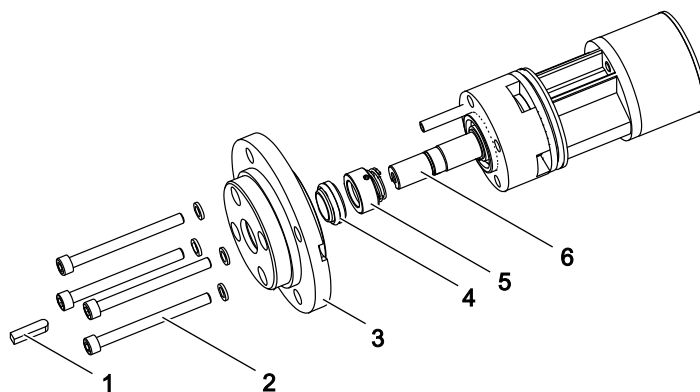
12.6 Replacing the mechanical seal

12.6.1 Removing the mechanical seal (DL2 from 320/DS1)

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Extractor

Requirement:

✓ Cartridge pump removed



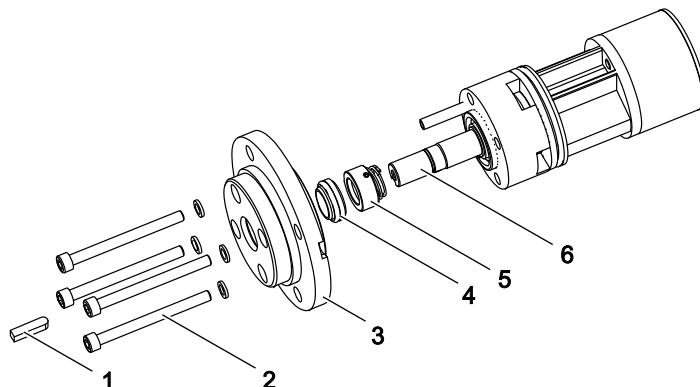
1. ➤ Remove the feather key **1** from the main screw **6**.
2. ➤ Remove the socket screws **2** and pump flange **3**.
3. ➤ Press the stationary seal ring **4** together with the O-ring out of the pump flange.
4. ➤ **Standard mechanical seal:** Remove rotary seal ring with spring **5** from the main screw.
Mechanical seal of hard material (without figure): Loosen the threaded pins. Remove the rotary seal ring and associated parts of the mechanical seal from the main screw.

12 Servicing

12.7 Replacing the radial shaft seal

12.6.2 Installing the mechanical seal (DL2 from 320/DS1)

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Silicone grease



- Clean the fitting surfaces, grease the O-ring of the stationary seal ring 4.
- Press the stationary seal ring with O-ring into the pump flange 3. Take the position of the recess for the dowel pin (anti-rotation screw).
- Clean the main screw 6 carefully in the area of the mechanical seal and grease it.
- **Standard mechanical seal:** Push the rotary seal ring with spring 5 onto the main screw.
Mechanical seal of hard material (without figure): Slide the rotary seal ring and associated parts of the mechanical seal onto the main screw and tighten the threaded pins.
- Clean the sliding surfaces of the mechanical seal carefully and grease lightly with silicone grease.
- Mount the pump flange with socket screws 2 with torque.
- Mount the feather key 1 on the main screw.

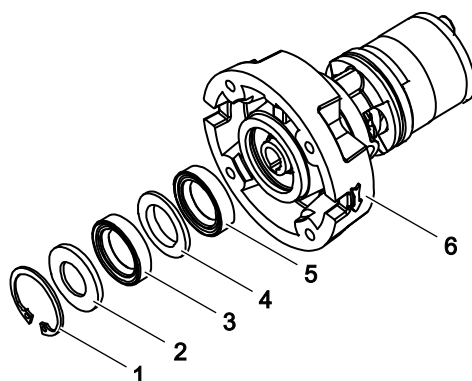
12.7 Replacing the radial shaft seal

12.7.1 Removing the radial shaft seal (DL2 to 240)

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Extractor

Requirement:

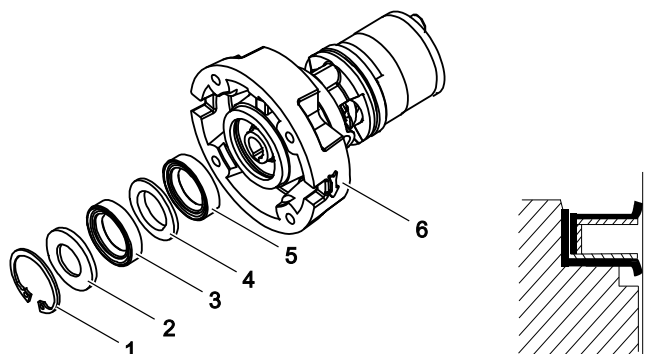
- ✓ Cartridge pump removed



- Remove the circlip 1 and supporting ring 2 from the cartridge housing 6.
- Remove the radial shaft seal ring 3 and 5 as well as the supporting ring 4.

12.7.2 Installing the radial shaft seal (DL2 to 240)

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Molybdenum disulphide paste (for example Fenkart T4)



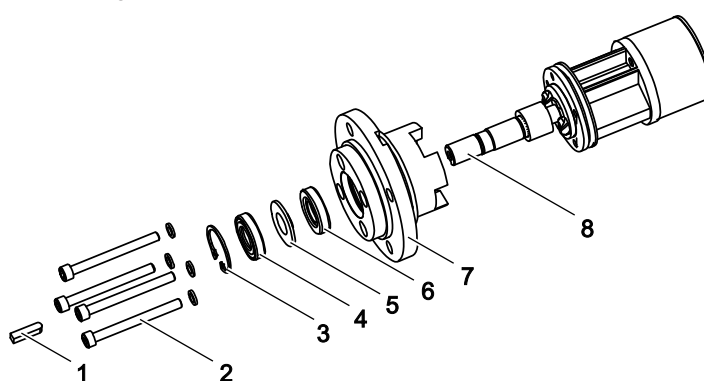
1. ➤ Clean the contact surface of the radial shaft seal rings **3** and **5** in the cartridge housing **6** carefully.
2. ➤ Carefully press radial shaft seal ring **5** into the cartridge housing. Take the mounting direction into account. In the case of excessive resistance apply additional thread sealant.
3. ➤ Fill the radial shaft seal ring with molybdenum disulphide paste (MoS_2).
4. ➤ Mount the supporting ring **4**.
5. ➤ Repeat Steps 3 and 4 for the radial shaft seal ring **3**.
6. ➤ Mount the supporting ring **2** and circlip **1**.

12.7.3 Removing the radial shaft seal (DL2 as of 320/DS1)

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Extractor

Requirement:

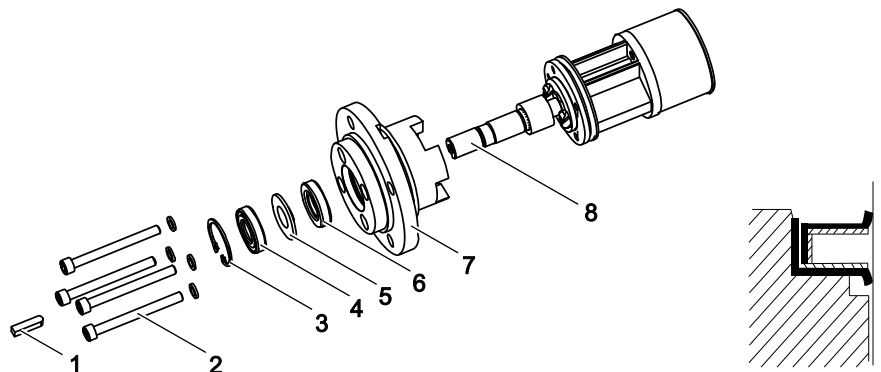
✓ Cartridge pump removed



1. ➤ Remove the feather key **1** from the main screw **8**.
2. ➤ Remove the socket screws **2** and pump flange **7**.
3. ➤ Remove the circlip **3**.
4. ➤ Press the radial shaft seal ring **4** and **6** as well as the supporting ring **5** from the pump flange.

12.7.4 Installing the radial shaft seal (DL2 as of 320/DS1)

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Molybdenum disulphide paste (for example Fenkart T4)



1. ➤ Clean the contact surface of the radial shaft seal ring **4** and **6** in the pump flange **7** carefully.
2. ➤ Carefully press the radial shaft seal ring **6** into the cartridge housing. Take the mounting direction into account. In the case of excessive resistance apply additional thread sealant.
3. ➤ Fill the radial shaft seal ring with molybdenum disulphide paste (MoS_2).
4. ➤ Mount the supporting ring **5**.
5. ➤ Carefully press the radial shaft seal ring **4** into the cartridge housing. Take the mounting direction into account. In the case of excessive resistance apply additional thread sealant.
6. ➤ Fill the radial shaft seal ring with molybdenum disulphide paste (MoS_2).
7. ➤ Mount the circlip **3**.
8. ➤ Mount the pump flange with socket screws **2** with torque.
9. ➤ Mount the feather key **1** on the main screw **8**.

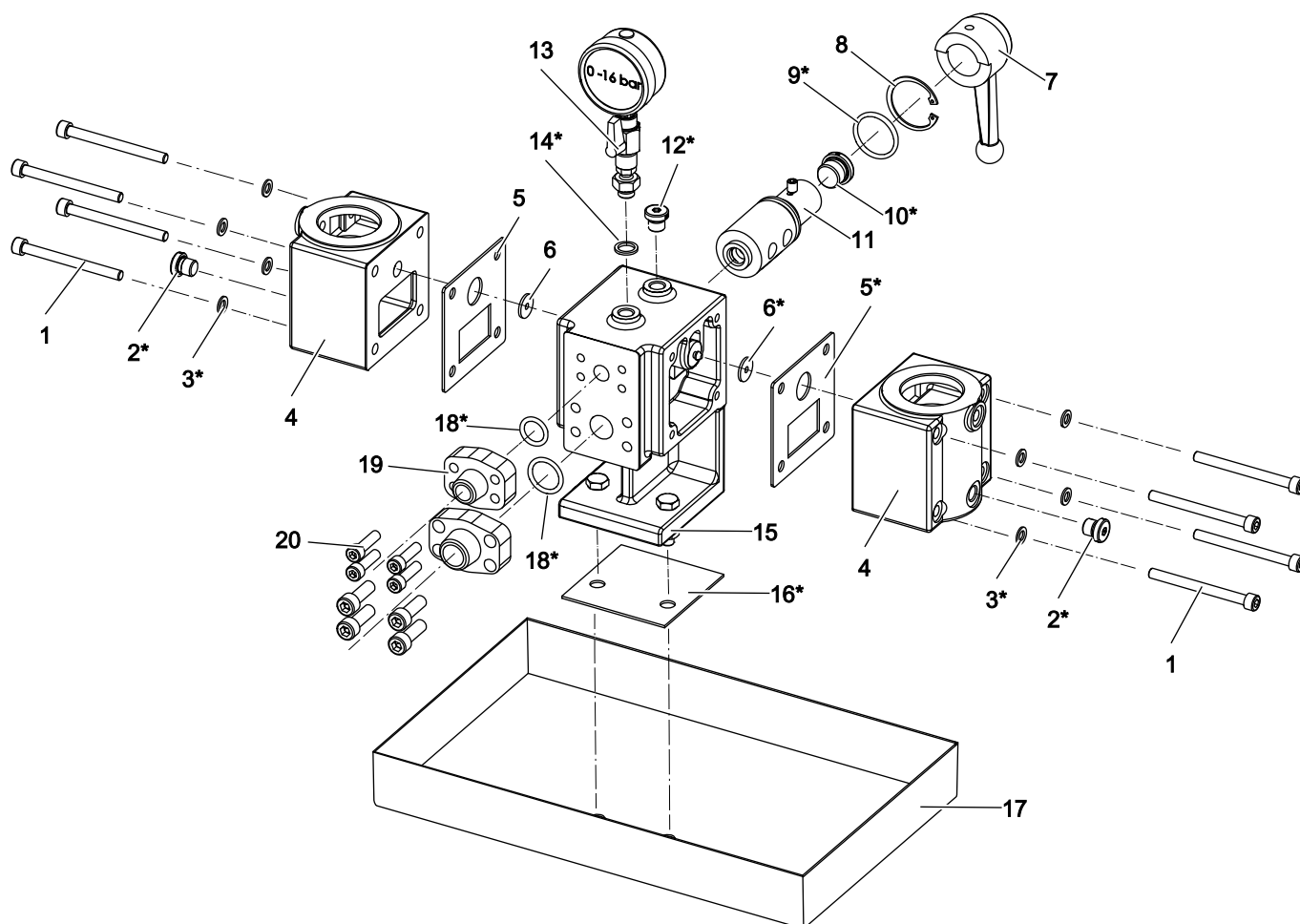
12.8 Replacing seals

Note The maintenance kit contains only the parts marked with * and is only supplied complete.

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Solvent <input type="checkbox"/> Silicone grease

Requirement:

✓ Pump station removed



Dismantling the housing and control block

1. ➤ Remove hexagon nuts and socket screws and remove the pump station from the oil pan 17.
2. ➤ Remove the flat gasket 16*.
3. ➤ Remove the socket screws 1 and O-ring 3* and remove the housing 4 from the control block 15.
4. ➤ Remove the flat gaskets 5* and 6*.

Control block: Remove the O-Ring 18*

1. ➤ Take off the socket screws 20, welding neck flange 19 and O-ring 18*.
2. ➤ Lightly grease the new O-ring and insert it.
3. ➤ Mounting welding neck flange with socket screws with torque.

Control block: Replace the screw plug 12*

➤ Replace the screw plug 12*.

Housing: Replace the screw plug 2*

➤ Replace the screw plug 2*.

13 Disposal

13.1 Dismantling and disposing of the pump station

Pressure gauge: Replace the copper seal 14*

- Remove the pressure gauge 13.
- Replace the copper seal 14* and mount the pressure gauge.

Reversing valve: Replace the O-ring 9* and screw plug 10*

- Remove the reversing valve lever 7, circlip 8, O-ring 9* and screw plug 10*
- Lightly grease the new O-ring and insert it.
- Mount the screw plug 10*, circlip 8 and reversing valve lever 7.

Mounting the housing and control block

- Clean the sealing surfaces, place the new flat gasket 5* and 6* on the control block.
- Lightly grease the new O-ring 3*.
- Mount the housing 4 at the control block with O-ring 3* and mount new socket screws 1 with torque.
- Clean the sealing surface and place on the new flat gasket 16*.
- Mount the pump station on the oil pan with socket screws and hexagon nuts with torque.
- Install the pump station ↪ Installation, removal, Page 14
- Filling and venting the pump ↪ Commissioning, Page 18.

13 Disposal

13.1 Dismantling and disposing of the pump station

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Face protection <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Solvents or industrial cleaners suitable for the pumped liquid <input type="checkbox"/> Collection tank



WARNING

Danger of poisoning and environmental damage through residues.

- ▶ Wear personal protective equipment during all the work. Ensure face protection.
- ▶ Before disposal collect any pumped or test liquid still present safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.
- ▶ Before disposing neutralize the residues.

Requirement:

- ✓ Disconnect the pump station from the power supply and secure it against being switched back on
 - ✓ Pump station cooled down to the ambient temperature and disconnected from the pipe system
 - ✓ Pump station drained completely
 - ✓ Pump station at a location suitable for dismantling
- Dismantle the pump station and disassemble it into its individual parts.
 - Clean residues of the pumped liquid from the individual parts.
 - Separate sealing elements made of elastomers and ceramics (SiC) from the pump station and dispose of them in separately.
 - Recycle iron parts.

14 Troubleshooting

14.1 Possible faults

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

Identification	Fault
1	No pump suction
2	Delivery rate too low
3	Pump too loud
4	Motor overload
5	Uneven delivery rate
6	Pump has seized
7	Shaft seal leaks

14.2 Troubleshooting

Fault identification							Cause	Remedy
1	–	–	–	–	–	–	Pump suction line closed	<div> <div></div> <div>Check the shut-off devices. If required, open.</div> </div>
1	2	3	–	5	–	–	Parts soiled (filter, suction line, suction valve, strainer)	<div> <div></div> <div>Clean parts.</div> </div>
1	2	3	–	5	–	–	Suction head too high	<div> <div></div> <div> <div>Reduce the level difference.</div> <div>-or-</div> <div>Reduce the line length.</div> <div>-or-</div> <div>Increase the line cross-section.</div> <div>-or-</div> <div>Heat up the pumped liquid.</div> <div>-or-</div> <div>Install a filter / strainer with a larger mesh width. Ensure that the permissible mesh width is not exceeded.</div> </div> </div>
1	–	3	–	–	–	–	Level in the intake container too low	<div> <div></div> <div>Fill the intake container.</div> </div>
1	–	–	–	–	–	–	Soiling of the filters/strainers	<div> <div></div> <div>Clean the filters/strainers ↗ Servicing, Page 26.</div> </div>
1	–	–	–	–	–	–	Too little pumped liquid in the pump	<div> <div></div> <div>Fill the pump with pumped liquid.</div> </div>
1	–	–	–	–	–	–	Incorrect pump direction of rotation	<div> <div></div> <div>Swop the two electrical connection phases ↗ Connection, Page 16.</div> </div>
1	–	3	4	5	–	–	Viscosity of the pumped liquid too high	<div> <div></div> <div> <div>Increase the temperature of the pumped liquid.</div> <div>-or-</div> <div>Decrease the speed.</div> </div> </div>
–	2	–	–	–	–	–	Viscosity of the pumped liquid too low	<div> <div></div> <div> <div>Reduce the temperature of the pumped liquid.</div> <div>-or-</div> <div>Increase the speed.</div> </div> </div>
–	2	3	–	5	–	–	Airlock/gas in the pumped liquid	<div> <div> <div>1. Test the pipe system for air admission, replace leaking parts.</div> <div>2. Reduce the suction head.</div> <div>-or-</div> <div>Increase the inlet pressure.</div> </div> </div>

14 Troubleshooting

14.2 Troubleshooting

Fault identification						Cause	Remedy
–	2	–	4	–	–	Speed/frequency/voltage of the motor false	<ol style="list-style-type: none"> 1. ➤ Ensure that the motor frequency and voltage match the operating voltage. 2. ➤ Ensure that the speed of the motor matches the rating plate of the pump. If necessary adjust the speed.
–	2	–	–	–	–	Advanced wear of the housing/screw set	<ol style="list-style-type: none"> ➤ Contact the manufacturer.
–	–	–	–	–	7	Advanced wear of sealing surfaces	<ol style="list-style-type: none"> ➤ Replace the seal and check the pumped liquid for abrasive substances. If required, replace the filter/strainer. -or- ➤ Contact the manufacturer.
–	–	3	–	–	–	Coupling aligned incorrectly	<ol style="list-style-type: none"> ➤ Assemble the coupling and motor correctly, see the associated operating instructions of the pumps.
–	–	3	–	–	–	Pump subject to mechanical stress	<ol style="list-style-type: none"> 1. ➤ Support the weight of the pipe system. 2. ➤ Connect the pump station correctly to the pipe system ➤ Connection, Page 16.
–	–	3	–	–	–	Vibrations/pulsations in the system	<ol style="list-style-type: none"> ➤ Bear the pump station elastically. -or- ➤ Make the connections with hoses.
–	–	3	–	–	–	Flow speed in the pressure line or suction line too high	<ol style="list-style-type: none"> ➤ Set the flow speed in the pressure line so that it does not exceed 3 m/s. -or- ➤ Set the flow speed in the suction line so that it does not exceed 1 m/s. -or- ➤ Contact the manufacturer.
–	–	3	4	–	7	Ball bearing damaged	<ol style="list-style-type: none"> ➤ Replace the ball bearing ➤ Servicing, Page 26.
–	2	3	4	–	7	Superficial damage to pump parts coming into contact with the liquid	<ol style="list-style-type: none"> ➤ Contact the manufacturer.
–	–	–	–	–	7	Shaft seal damaged through dry running	<ol style="list-style-type: none"> ➤ Replace the shaft seal, see corresponding operating instructions of the pump.
–	–	–	–	–	7	Inlet pressure too high	<ol style="list-style-type: none"> 1. ➤ Reduce the inlet pressure at the system side. 2. ➤ Replace the shaft seal, see corresponding operating instructions of the pump.
–	–	–	–	–	7	Inlet pressure too low	<ol style="list-style-type: none"> ➤ Install a non-return valve at the pressure side.
–	–	–	–	–	7	Shaft seal is overloaded through thermal/chemical influences	<ol style="list-style-type: none"> 1. ➤ Check the maximum operating temperature. 2. ➤ Check the suitability and resistance of the elastomers with regard to the pumped liquid. -or- ➤ Contact the manufacturer.
–	–	–	–	–	7	Overload of the shaft seal by pressure build-up during the heating process	<ol style="list-style-type: none"> ➤ Open the pressure-side/suction-side shut-off device in order to avoid a pressure build-up through heat expansion of the pumped liquid.
1	2	3	4	5	–	Cold start when delivering high-viscosity liquids	<ol style="list-style-type: none"> ➤ Install the heating system.
–	–	3	–	–	6	Differential pressure is too high and has overloaded the idle screws	<ol style="list-style-type: none"> ➤ Contact the manufacturer.
–	–	3	–	–	6	Viscosity is too low and has overloaded the idle screws	<ol style="list-style-type: none"> ➤ Contact the manufacturer.

Fault identification							Cause	Remedy
1	2	3	4	–	–	7	Pump damaged through dry running	<div></div> <div>→ Contact the manufacturer.</div>
1	–	–	–	–	–	–	Pump does not vent	<div></div> <div>→ Vent the pressure line at the highest point.</div>
1	2	3	–	–	–	–	Reversing valve lever in the incorrect position	<div></div> <div>→ Switch the lever of the reversing valve to the correct position ↗ During operation, Page 21.</div>
–	2	–	–	5	–	–	Pressure maintaining valve set incorrectly	<div></div> <div>→ Set the pressure maintaining valve ↗ During operation, Page 21.</div>
–	–	3	4	–	–	7	Ball bearing damaged	<div></div> <div>→ Replace the ball bearing ↗ Servicing, Page 26.</div>

Tab. 11: Fault table

15 Accessories

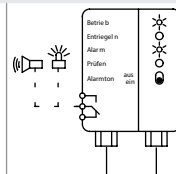
15.1 Pump station accessories

Detailed information is provided in the respectively associated technical documentation.

Accessories/function

Leak oil monitoring

- ☐ Monitoring of the leak oil quantity in the oil pan
- ☐ To be used with an elevated oil pan



Tab. 12: Pump station accessories

16 Spare parts

16.1 Overview

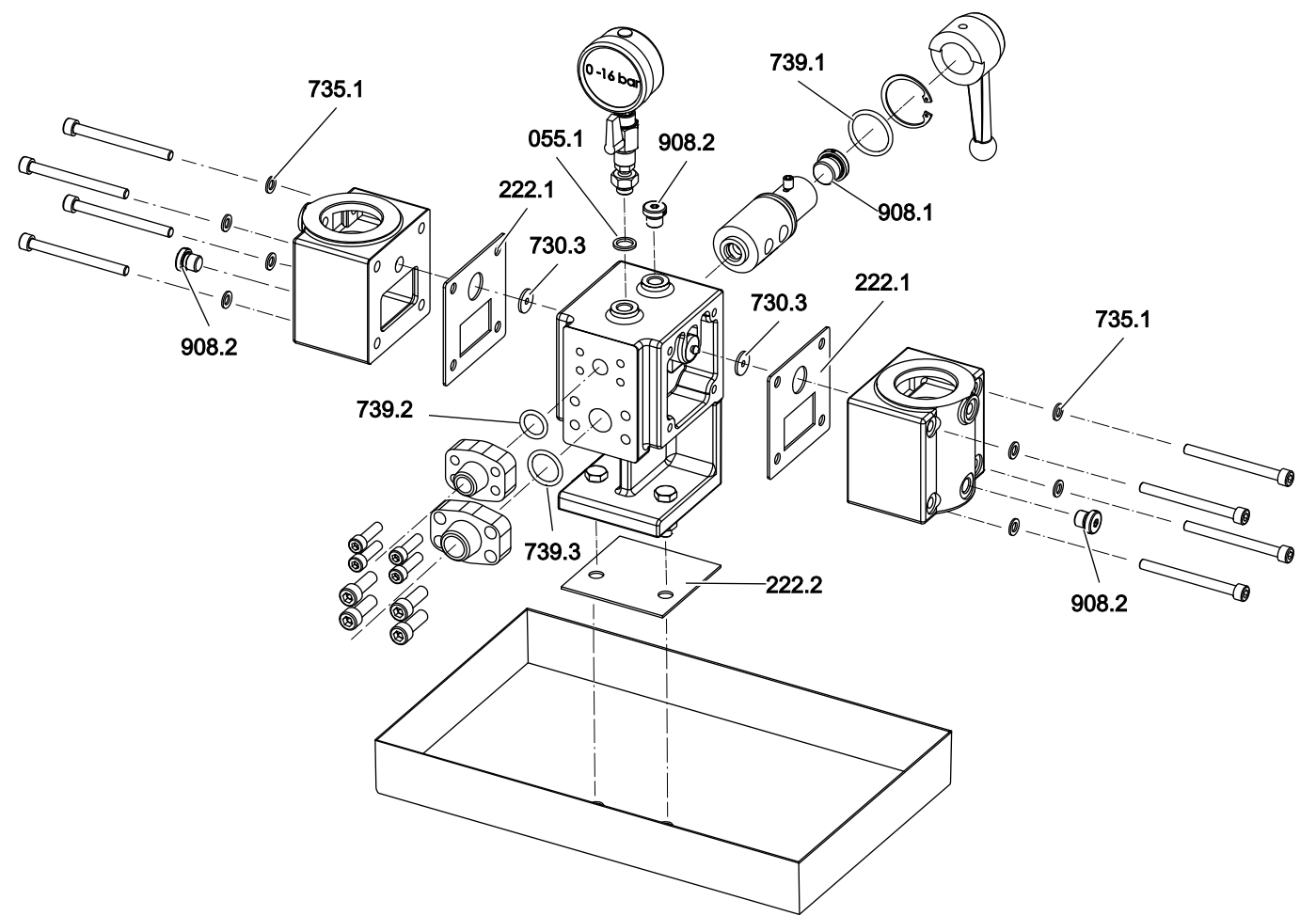
Model/Size	Type	Variant
DL2- 150 – 1300	Gasket kit	Pump station
DL2- 150 – 240	Gasket kit	Radial shaft seal
DL2- 320 – 1300/DS1	Gasket kit	Radial shaft seal
DL2- 320 – 1300/DS1	Gasket kit	Mechanical seal
DL2- 150 – 1300	Repair kit	Overflow valve
DL2- 150 – 1300	Repair kit	Return valve

Tab. 13: Overview of spare parts

16.2 Gasket kits

16.2.1 Gasket kit pump station

Note The gasket kit contains only the numbered parts and is only supplied complete.

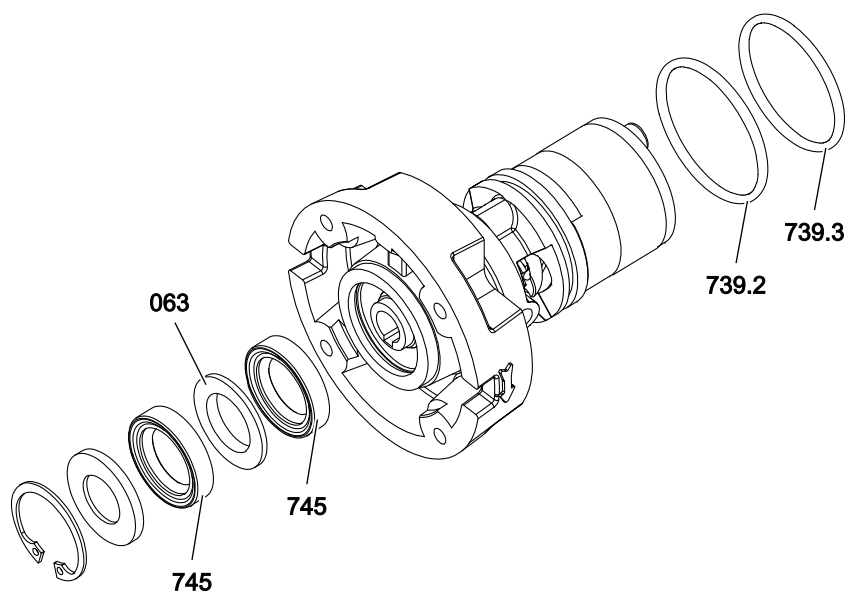


Qty.	Item No.	Part
1	055.1	Copper seal
2	222.1	Flat gasket
1	222.2	Flat gasket
2	730.3	Flat gasket
8	735.1	Copper seal
1	739.1	O-ring
1	739.2	O-ring
1	739.3	O-ring
1	908.1	Screw plug
3	908.2	Screw plug

Tab. 14: Gasket kit pump station

16.2.2 Gasket kit radial shaft seal (DL2 to 240)

Note The gasket kit contains only the numbered parts and is only supplied complete.



Qty.	Item No.	Part
1	063	Support ring
1	739.2	O-ring
1	739.3	O-ring
2	745	Radial shaft seal ring

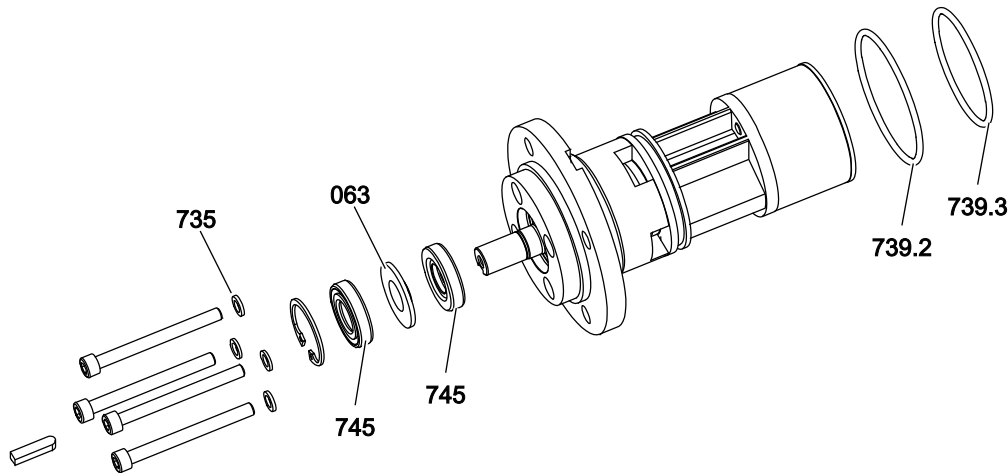
Tab. 15: Gasket kit pump (DL2 to 240)

16 Spare parts

16.2 Gasket kits

16.2.3 Gasket kit radial shaft seal (DL2 as of 320/DS1)

Note The gasket kit contains only the numbered parts and is only supplied complete.

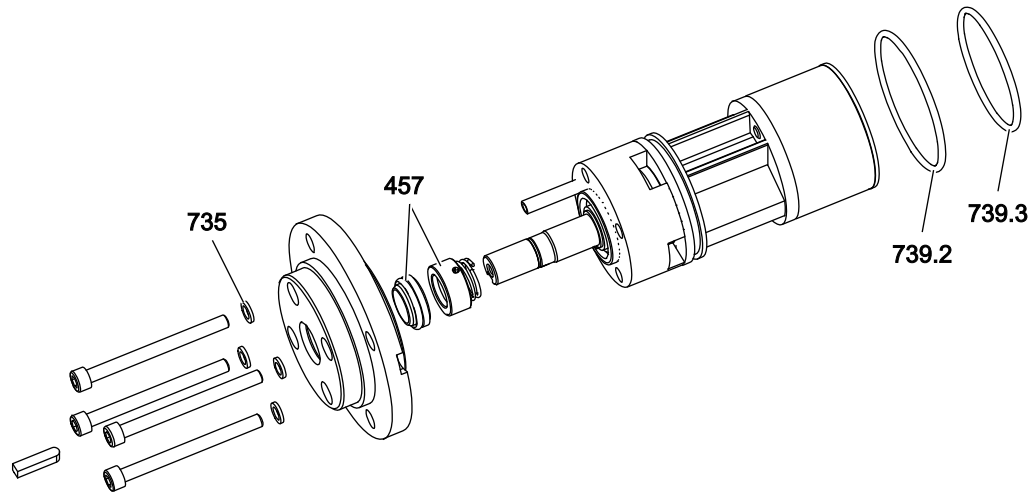


Qty.	Item No.	Part
1	063	Support ring
4	735	Copper seal
1	739.2	O-ring
1	739.3	O-ring
2	745	Radial shaft seal ring

Tab. 16: Gasket kit radial shaft seal (DL2 as of 320/DS1)

16.2.4 Gasket kit mechanical seal (DL2 as of 320/DS1)

Note The gasket kit contains only the numbered parts and is only supplied complete.



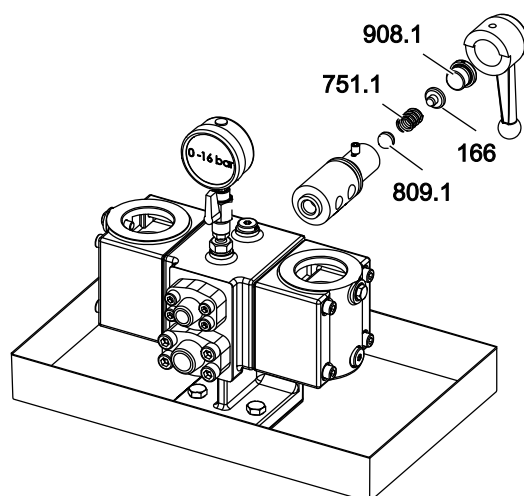
Qty.	Item No.	Part
1	457	Mechanical seal
4	735	Copper seal
1	739.2	O-ring
1	739.3	O-ring

Tab. 17: Gasket kit mechanical seal (DL2 as of 320/DS1)

16.3 Repair kits

16.3.1 Repair kit, overflow valve

Note The repair kit contains only the numbered parts and is only supplied complete.

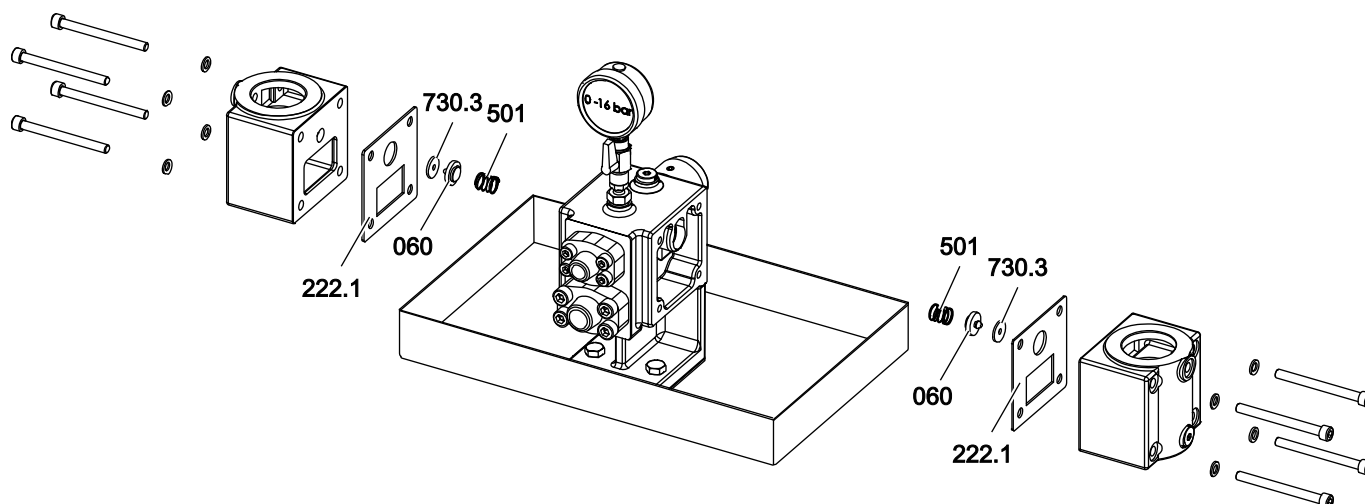


Qty.	Item No.	Part
1	166	Adjusting screw
1	751.1	Pressure spring
1	809.1	Ball
1	908.1	Screw plug

Tab. 18: Repair kit, overflow valve

16.3.2 Repair kit non-return valve

Note The repair kit contains only the numbered parts and is only supplied complete.



Qty.	Item No.	Part
2	060	Washer
2	222.1	Flat gasket
2	501	Pressure spring
2	730.3	Flat gasket

Tab. 19: Repair kit non-return valve

17 Appendix

17.1 Tightening torques for screws with metric screw threads with and without wedge lock washers

Note In the case of galvanised screw plugs and screw plugs made of stainless steel the inner thread and outer thread have to be greased thorough before mounting in order to prevent threads from seizing.

Note The manufacturer recommends tightening screws with wedge lock washers according to the table three times after another with the same tightening torque

Tightening torque [Nm]							
Screws with head contact surface					Countersunk screws		
Thread					Stainless steel screws A2 and A4		8.8
	5.6	8.8	10.9	8.8+ Alu*	Property class 70	Property class 80	
M 3	0.6	1.5	–	1.2	1.1	1.3	1.0
M 4	1.4	3.0	4.1	2.3	2.0	2.3	2.0
M 5	2.7	6.0	8.0	4.8	3.9	4.7	5.0
M 6	4.7	10.3	14.0	7.6	6.9	8.0	9.0
M 8	11.3	25.0	34.0	18.4	17.0	22.0	14.0
M 10	23.0	47.0	68.0	36.8	33.0	43.0	36.0
M 12	39.0	84.0	117	64.0	56.0	75.0	60.0
M 14	62.0	133	186	101	89.0	–	90.0
M 16	96.0	204	285	155	136	180	100
M 18	133	284	390	224	191	–	–
M 20	187	399	558	313	267	370	135
M 24	322	687	960	540	460	605	360

Tab. 20: Tightening torques metric screw thread

*When screwing into aluminium, the tightening torque reduces by 20 % when the screw-in depth is less than double the thread diameter.

17.2 Tightening torques for screw plugs with thread measured in inches and elastomer seal

Note In the case of galvanised screw plugs and screw plugs made of stainless steel the inner thread and outer thread have to be greased thorough before mounting in order to prevent threads from seizing.

Tightening torque [Nm]	
Thread	Galvanized + stainless steel
G 1/8"	13.0
G 1/4"	30.0
G 3/8"	60.0
G 1/2"	80.0
G 3/4"	120
G 1"	200
G 1 1/4"	400
G 1 1/2"	450

Tab. 21: Tightening torques with thread measured in inches

17.3 Contents of the Declaration of Conformity

The products described in these instructions are machinery in the sense of the Directive 2006/42/EC. The original of the EC Declaration of Conformity is enclosed with the machinery at delivery.

The machinery fulfils all the relevant provisions of the following directives:

Number	Name	Remark
2006/42/EC	Machinery Directive	–
2014/68/EU	Pressure Equipment Directive	–
2014/30/EU	Directive on Electromagnetic Compatibility	Only for machinery with electrical components
2014/35/EU	Low Voltage Directive	Only for machinery with electrical components
2014/34/EU	Directive on Use in Potentially Explosive Areas (ATEX)	Only for machinery in ATEX version

Tab. 22: Directives observed



KRAL

