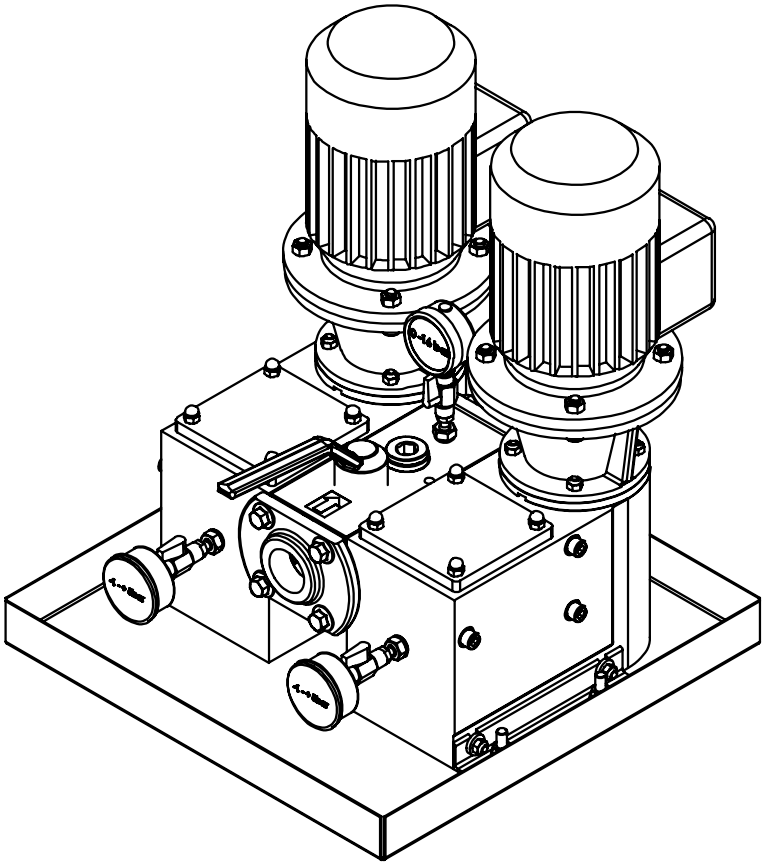
Operating instructions



KRAL pump stations.

Series DL3 / DL4 / DS1 / DS3 / DS4

Magnetic coupling

The safety instructions for persons with cardiac pacemakers, metallic implants or neurostimulators must be observed.

OID 07en-GB
Edition 2024-07
Original instructions

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.
	Magnetic field	Magnetic field can cause 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 of the pump unit can cause burns.

1.4.3 Symbols in this document

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

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.

2.4.2 Dangers at magnetic coupling systems

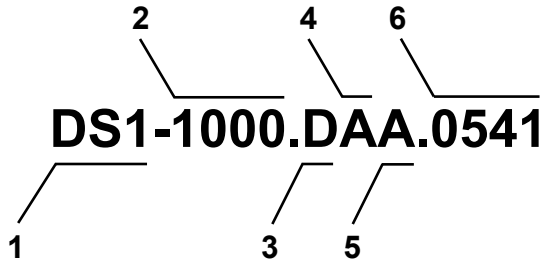
Magnetic fields from magnetic coupling systems (MCS) can influence the function and operational safety of electrical and electronic devices. The following safety instructions must be observed.

The following safety instructions must be observed:

- ☐ Keep the MCS away from cardiac pacemakers. There is a danger to life!
  - Under no circumstances may persons with cardiac pacemakers perform installation, dismantling or maintenance work.
- ☐ Persons with cardiac pacemakers must comply with the following safe distances to the MCS:
  - 3 m distance to the openly accessible MCS
  - 1 m distance to pump units with installed MCS
- ☐ Do not bring the MCS in the immediate area of PCs, data carriers and other electronic components.
- ☐ Keep the MCS away from clocks, magnetized tools and measuring equipment as well as all magnetizable parts.
- ☐ Do not bring both the MCS parts together, as this can destroy the magnetic coupling system.

3 Identification

3.1 Type code



1 Type
2 Size
3 Shaft seal
4 Bearing
5 Heating
6 Version index

Fig. 1: Type code

Item	Classification	Description	
1	Type	DS1	☐ Station with pumps of the NE series ☐ Pumping of heavy fuel oil to 1300 l/h ☐ Pressure build-up up to 6 bar
		DS3	☐ Station with pumps of the NE series ☐ Pumping of light oil/heavy fuel oil to 2900 l/h ☐ Pressure build-up up to 6 bar
		DS4	☐ Station with pumps of the NE series ☐ Pumping of light oil/heavy fuel oil to 6000 l/h ☐ Pressure build-up up to 6 bar
2	Size		Corresponds to the delivery rate in [l/h] at rated speed
3	Shaft seal	A	Standard radial shaft seal
		B	Standard mechanical seal
		C	Mechanical seal of hard material
		D	Magnetic coupling
4	Bearing	A	Inner bearing
		B	Outer bearing
5	Heating	A	Without heating
		B	With heating system
6	Version index		For internal administration

Tab. 2: Type code

3.2 Rating plate

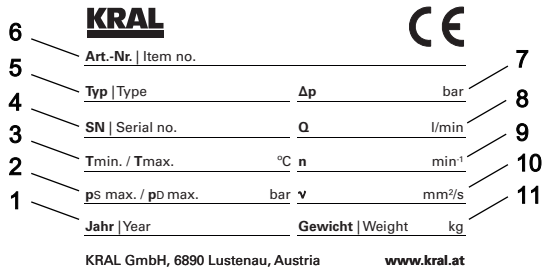


Fig. 2: Rating plate

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 Assignment of the sizes of pump station and pump

DS1	NE	DS3	NE	DS4	NE
150	5	900	15	1600	32
240	5	1100	20	2000	40
320	10	1500	26	3200	32
400	7	1800	15	4000	40
500	10	2300	20	6000	54
750	7	2900	26		
1000	10				
1300	13				

Tab. 3: Pump station DS - pump NE assignment

4.2 Operating limits

Parameter	Unit	DS1, DS3, DS4
Max. operating pressure	[bar]	6.0
Max. inlet pressure		
☐ Radial shaft seal	[bar]	0.5
☐ Mechanical seal	[bar]	5.0
Min. – max. temperature of pumped liquid	[°C]	10 – 180
Min. – max. viscosity	[mm^2/s]	2 – 1000
Min. – max. ambient temperature	[°C]	-20 ... 50

Tab. 4: Pump station operating limits

4.3 Filling volume

Parameter	Unit	DS1	DS3	DS4
Pump station filling volume	[l]	3.6	9.0	9.0

Tab. 5: Pump station filling volume

4.4 Inlet pressure for heavy fuel oil

The water contained in the heavy fuel oil evaporates at high temperatures and inlet pressure that is too low. The diagram shows the minimum inlet pressure to be complied with at the suction side connection depending on the temperature in operation. The maximum temperature amounts to 150 °C.

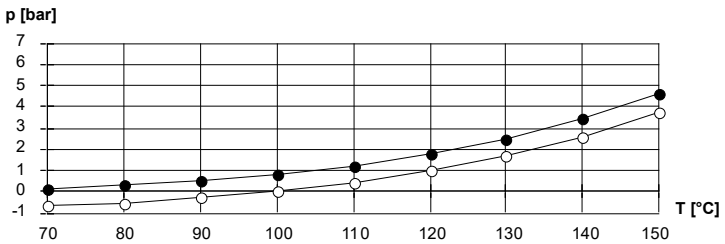


Fig. 3: Inlet pressure for heavy fuel oil

p Inlet pressure
T Temperature
● Recommended inlet pressure
O Evaporating pressure water

4.5 Sound pressure level

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

	DS1 size							
	150	240	320	400	500	750	1000	1300
	Max. sound pressure level ±3 [dB(A)]							
Pump	45.0	46.2	47.7	47.9	49.1	50.4	51.8	53.6
Motor	45.0	44.0	45.0	44.0	44.0	54.0	54.0	54.0
1 pump unit	48.0	48.3	49.6	49.3	50.3	55.6	56.1	56.8
2 pump units	49.8	50.3	51.8	51.7	52.7	56.7	57.4	58.1

Tab. 6: DS1 sound pressure level

	DS3 size						DS4 size				
	900	1100	1500	1800	2300	2900	1600	2000	3200	4000	6000
	Max. sound pressure level ±3 [dB(A)]										
Pump	50.2	51.5	52.8	53.0	54.6	56.1	52.9	54.5	56.2	58.0	60.1
Motor	44.0	44.0	44.0	55.0	55.0	59.0	46.0	46.0	60.0	60.0	60.0
1 pump unit	51.1	52.2	53.3	57.1	57.8	60.8	53.7	55.1	61.5	62.1	63.1
2 pump units	53.7	54.9	56.1	58.5	59.5	62.1	56.3	57.8	62.6	63.5	63.8

Tab. 7: Sound pressure level DS3 and DS4

4.6 Mesh width strainer/filter

Options	Usage	Viscosity [mm²/s]	Mesh width [mm]
Strainer	Separation of coarse soiling during operation	< 20	0.25
		> 20	0.50
Strainer commissioning / filter commissioning	Protection of the station during commissioning	–	0.02
Operating filter	Protection of the station during operation	–	Depending on the pumped liquid

Tab. 8: Strainer/filter mesh width

4.7 Weights

The weight is specified on the rating plate.

4.8 Accessories

Note The technical data of the accessories are specified separately ↳ Accessories, Page 52.

5 Function description

5.1 Structure

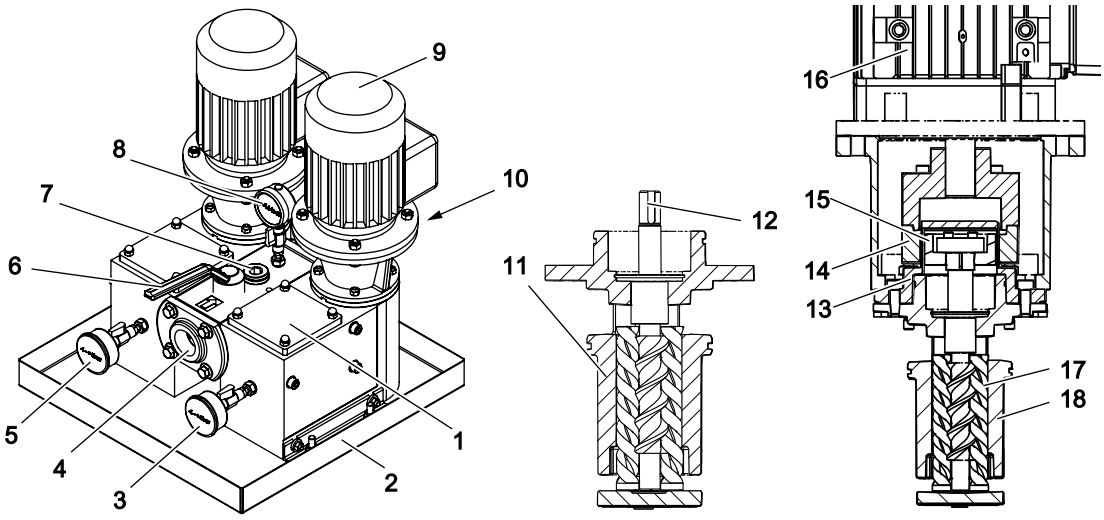


Fig. 4: Structure – principle diagrams

1	Strainer cover	**10**	Pressure-side connection
2	Oil pan	**11**	Screw pump
3	Suction-side pressure gauge	**12**	Main screw (shaft end)
4	Suction-side connection	**13**	Containment can
5	Suction-side pressure gauge	**14**	Outer rotor
6	Reversing valve	**15**	Inner rotor
7	Overflow valve	**16**	Motor
8	Pressure-side pressure gauge	**17**	Idle screw
9	Motor	**18**	Cartridge housing

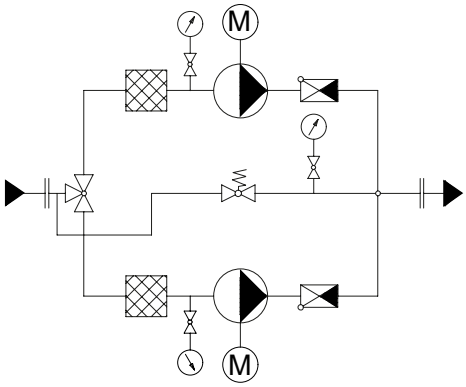


Fig. 5: Hydraulic scheme

5.2 Functional principle

DS1, DS3 and DS4 series pump stations are suitable for pumping light or heavy oil.

The pump stations are equipped with two KRAL NE series screw pumps.

Screw pumps are rotating displacement pumps. The displacement effect results from three rotating screws **12** and **13** and the enclosing cartridge housing **14**. Radial support of the screw set is provided 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, suspended solids cannot be pumped.

The pump station is connected to the pipe system via the connections **4** and **10**. Depending on the position of the reversing valve **6** the pumped liquid flows through the left, right or both pumps.

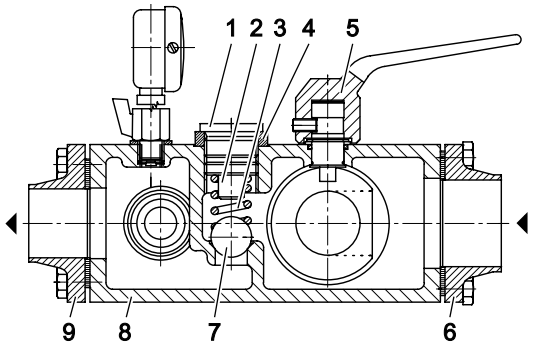
The oil pan **2** collects leaks from the pump station.

5.3 Magnetic coupling

The shaft end of the pump **12** is enclosed by a containment can **13** that is connected air-tight with the motor-side flange of the pump. Therefore, it is not necessary to seal a rotating free shaft end against a stationary seal housing. Special rotors equipped with powerful permanent magnets are used for transfer of torque from the motor to the pump. The inner rotor **15** is fixed at the shaft end and driven by the outer rotor **14**, which in turn is fixed to the shaft of the motor **16**. The torque is thus transferred contact-free by means of the magnetic field between the outer rotor and inner rotor.

The containment can is made of a non-magnetic material which does not impede the forming of magnetic flux lines between the rotors. The pressure discharge of the containment can is effected via a core drilled hole in the main screw. Therefore, it can be assumed that the pressure in the containment can approximately corresponds to the pressure on the suction side of the pump.

5.4 Overflow valve



1 Screw plug
2 Adjusting screw
3 Pressure spring
4 Seal ring
5 Reversing valve lever
6 Suction-side connection
7 Valve ball
8 Control block
9 Pressure-side connection

Fig. 6: 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 **1** and can be adjusted from the outside During operation, Page 26.

Note
- ☐ A function test of the overflow valve at least every 5 years is essential for the safe operation During operation, Page 26.
- ☐ 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.

5.5 Reversing valve

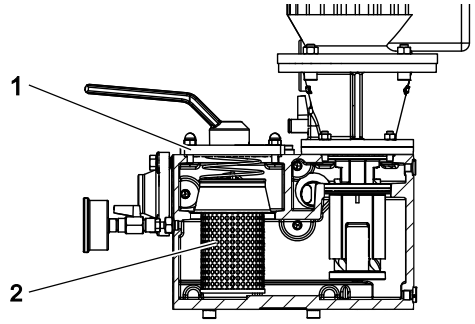
If the lever of the reversing valve **6** is in one of the two side positions, the respectively other line of the station is separated from the fluid circuit so that the strainer of this line can be opened and cleaned. If the lever is in the centre position, both lines are connected to the fluid circuit. The delivery rate can thus be increased through parallel operation of the two pumps. If only one pump is being operated, the second pump can be cut in automatically if the delivery rate or the pressure drops at the active line. In order to ensure a uniform distribution of the operating hours, an interval-controlled automatic switch-over between the two pumps is also possible in this valve position. The non-return valves ensure that the respective pump that is stopped does not begin to rotate backwards.

5.6 Pressure measurement

A pressure gauge **8** is located 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**. In order to monitor the pressure on the suction sides of the two pumps, two further pressure gauges **3** and **5** are mounted. These pressure gauges show only the respective pressure at one of the two strainers and can be used to monitor the degree of soiling of the strainers. The pressure gauge in the blocked line shows only the inner pressure of the blocked strainer.

The shut-off valves at the pressure gauges may only be opened to read the pressure values, During operation, Page 26.

5.7 Strainer



1 Strainer cover
2 Strainer insert

Fig. 7: Strainer

The pump station is equipped with two strainers as standard. These strainers serve to separate soiling that is normally not contained in the pumped liquid. Due to their small size the strainers cannot separate larger amounts of soiling occurring regularly, nor abrasive fine particles. In the case of such operating conditions the pump station has to be protected additionally by a correspondingly dimensioned operating filter. Very fine abrasive particles can, however, not be held back by the operating filter and cause increased wear to the pumps.

Alternatively the strainers can be replaced during commissioning by fine-meshed commissioning strainers Commissioning, Page 22. The commissioning strainer is available from the manufacturer. A further possibility is the use of an external commissioning filter.

The strainer inserts are made of metal and can be cleaned and reused Maintenance, Page 30.

Recommended mesh width of strainer and filter Technical data, Page 9.

6 Transportation, storage

6.1 Dangers during transportation

The following safety instructions must be observed
☐ Have all work only carried out by authorized qualified personnel.
☐ A crane operator and transport personnel are required for transportation (2 persons).
☐ 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.
☐ Cordon off the danger zone and ensure that unauthorized persons cannot enter the danger zone.

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:	☐ Transport personnel
Personal protective equipment:	☐ Work clothing ☐ Protective helmet ☐ Protective gloves ☐ Safety boots
Aids:	☐ Mobile crane, forklift, hoisting equipment

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

⚠ 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.

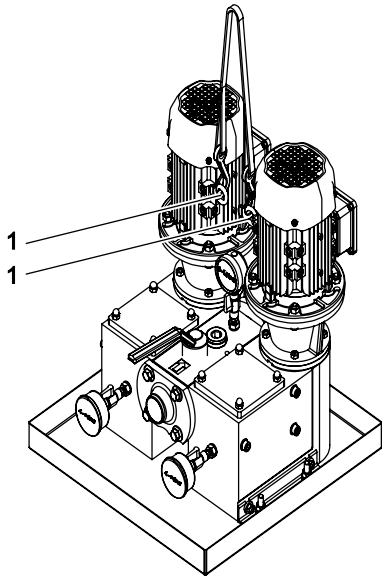


Fig. 8: Fastening of hoisting equipment

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.

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:	☐ Transport personnel
Aids:	☐ Mobile crane, forklift, hoisting equipment

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

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 15.

7 Preservation

7.1 Preservation table

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

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

Tab. 9: Conditions for additional preservation

7.2 Preserving the inner surfaces

Personnel qualification:	☐ Trained personnel
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
Aids:	☐ Castrol Rustilo DWX 21 or other preservative offering comparable protection

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

1. ▶ Open the strainer cover.

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 strainer cover.
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:	☐ Trained personnel
Personal protective equipment:	☐ Work clothing ☐ Face protection ☐ Protective gloves ☐ Safety boots
Aids:	☐ Calcium complex grease (for example TEVI-ER® GREASE WAWE 100 with adhesive additive) ☐ Castrol Rustilo DWX 21 or other preservative offering comparable protection

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

1. Brush calcium complex grease corrosion protection (for example TEVIER® FETT WAWE 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:	☐ Trained personnel
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
Aids:	☐ Solvent ☐ Steam-jet cleaning device with wax-dissolving additives ☐ Collection tank

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

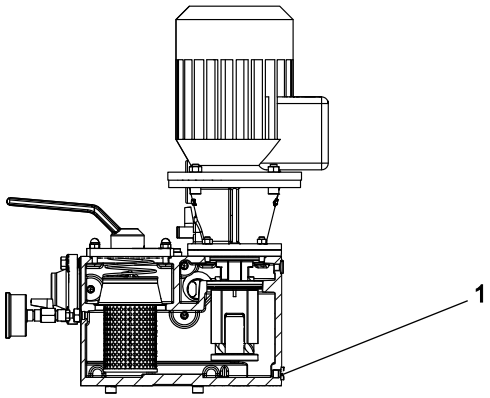
► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

⚠ 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.
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 61.
- ☐ 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:	☐ Transport personnel ☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
Aids:	☐ Mobile crane, forklift, hoisting equipment

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

⚠ 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.

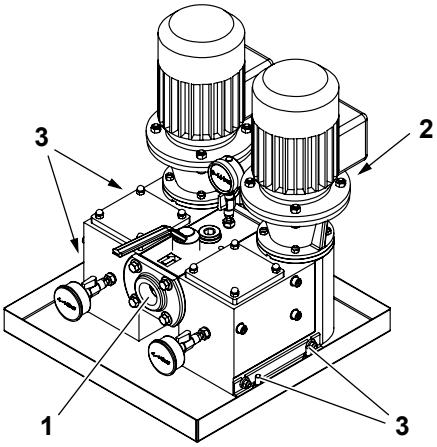


Fig. 9: Mounting the pump station

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

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 22.

8.4 Removing the pump station

Personnel qualification:	☐ Transport personnel ☐ Fitter ☐ Electrician
Personal protective equipment:	☐ Work clothing ☐ Protective helmet ☐ Protective gloves ☐ Safety boots
Aids:	☐ Mobile crane, forklift, hoisting equipment ☐ Collection tank

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

- ► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

⚠ 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).

⚠ DANGER

Risk of death through emitted pumped liquid.

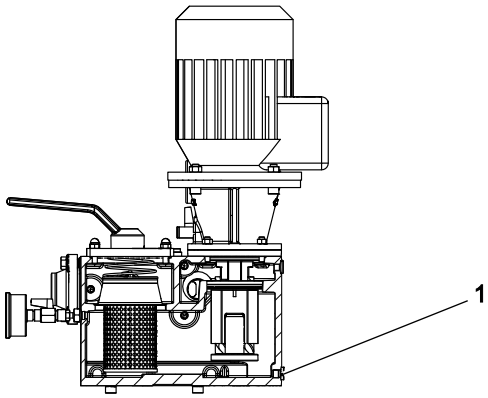
Pumped liquids can be hot, poisonous, combustible and caustic and can spray out under high pressure.

- ► 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

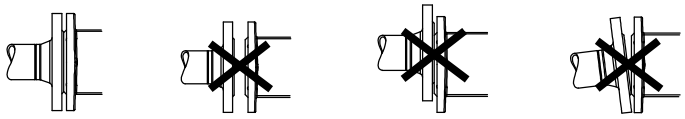


Fig. 10: Connecting the piping

Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Protective helmet ☐ Safety boots
Aids:	☐ Mobile crane, forklift, hoisting equipment ☐ Torque wrench

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

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:	☐ Electrician
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

- ► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

⚠ 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:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Protective helmet ☐ Safety boots

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

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 station

Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective helmet ☐ Face protection ☐ Protective gloves ☐ Safety boots

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

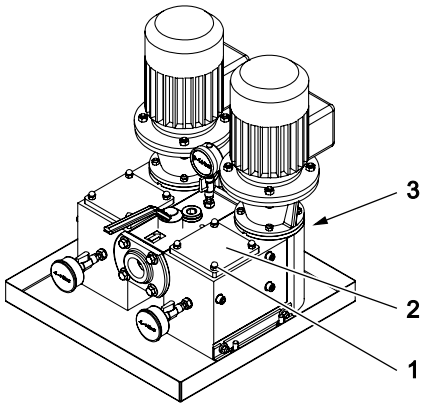
⚠ WARNING

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. ▶ Open the screw plug of the vent hole **3** by a max. of two rotations so that air can escape during the filling process.
2. ▶ Remove the cap nuts **1** and remove the strainer cover **2**.
3. ▶ Fill the pump through the strainer chamber up to the upper edge, in the process turn the fan impeller of the motor.
4. ▶ Place on the strainer cover and cap nuts.
5. ▶ Tighten the screw plug of the vent hole with torque, ↳ Appendix, Page 61.
6. ▶ Repeat the filling procedure for the second pump.

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:	☐ Fitter

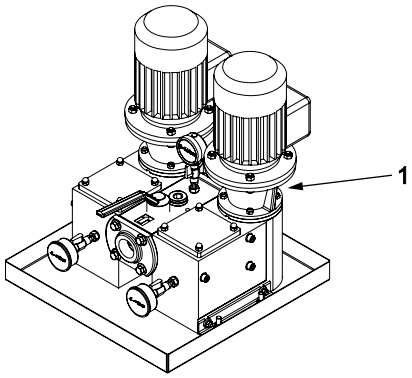
⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

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:	☐ Fitter ☐ Electrician
Personal protective equipment:	☐ Work clothing ☐ Protective helmet ☐ Protective gloves ☐ Safety boots ☐ Face protection
Aids:	☐ Collection tank

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

⚠ 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.

⚠ WARNING

Risk of injury through emitted pumped liquid.

Bursting of the containment can due to damage by iron particles in the medium.

► Install filter/strainer with magnetic separator on suction side.

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:

✓ Filter/strainer with magnetic separator installed on suction side
✓ 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 50.
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 26.

10.3 During operation

10.3.1 Checking the operating pressure

Personnel qualification:	☐ Trained personnel

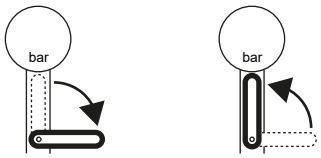


Fig. 11: Pressure gauge shut-off valves closed/open - principle diagram

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

ATTENTION

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

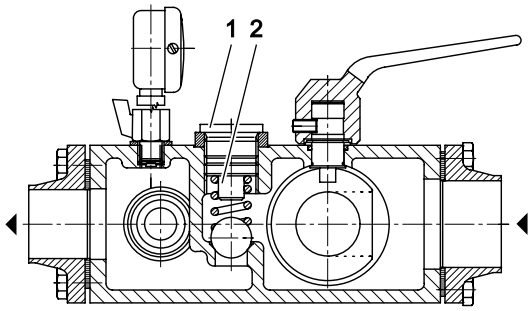
► Close the pressure gauge shut-off valve immediately after completing reading.

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

10.3.2 Adjusting the overflow valve

Personnel qualification:	☐ Fitter
Aids:	☐ 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. 12: Adjusting the overflow valve

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

⚠ 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.

10.3.3 Test the overflow valve

Personnel qualification:	☐ Trained personnel
Personal protective equipment:	☐ Work clothing ☐ Face protection ☐ Protective gloves ☐ 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 30

✓ 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.

10.3.4 Activating the reversing valve

Personnel qualification:	☐ Trained personnel

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

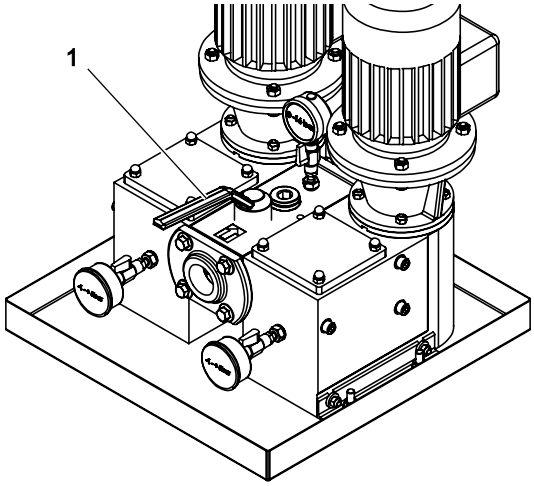


Fig. 13: Reversing valve lever

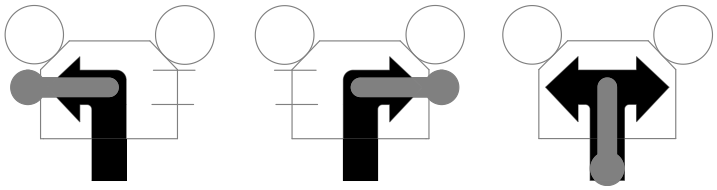


Fig. 14: Positions of the reversing valvel

Note The reversing valve can be operated during operation.

1. Turn the lever **1** to the left.
   ⇨ The left-hand strainer and the left-hand pump are connected with the pipe system.
2. Turn the lever **1** to the right.
   ⇨ The right-hand strainer and the right-hand pump are connected with the pipe system.
3. Turn the lever **1** into the middle position.
   ⇨ Both strainers and both pumps are connected with the pipe system.

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

10.3.5 Monitoring the filter and/or strainer

Note The manufacturer recommends protecting the pump against soiling by means of a filter and/or strainer installed at the system end (mesh width 0.5 mm). The degree of soiling of the filter and/or the strainer can be monitored by means of a suction-side pressure gauge or a differential pressure indicator.

Personnel qualification:	☐ Trained personnel

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

⚠ WARNING

Risk of injury through emitted pumped liquid.

Bursting of the containment can due to damage by iron particles in the medium.

► Install filter/strainer with magnetic separator on suction side.

1. ▶ After commissioning monitor the degree of soiling of the filter and/or strainer by means of a suction-side pressure gauge or a differential pressure indication.
2. ▶ Also check the filters/strainers in the event of a pressure drop on the suction side. Observe the dimensioning data of the manufacturer of the filters and/or strainers.
3. ▶ Check the suction-side pressure every two weeks during operation.
4. ▶ Regularly check the magnetic separator in the filter/strainer during operation and clean it if necessary.

10.3.6 Switching off the pump station

Personnel qualification:	☐ Trained personnel

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

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:	☐ Fitter ☐ Electrician
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots ☐ Face protection
Aids:	☐ Collection tank

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

⚠ 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
☐ Pump station shut down for longer period	→ Depending on the pumped liquid
☐ Pump station drained	→ Close the pressure- and suction-side shut-off devices.
☐ Pump station dismantled	→ Disconnect the motors from the power supply and secure against being switched back on.
☐ Pump station stored	→ Observe measures for storing and preservation Transportation, storage, Page 13.

Tab. 10: Measures during operation interruptions

Behaviour of the pumped liquid	Duration of the operation interruption	
	Short	Long
☐ Solids sediment	→ Flush the pump station.	→ Flush the pump station.
☐ Congealed/frozen ☐ No corrosive burden	→ Heat or drain the pump station.	→ Drain the pump station.
☐ Congealed/frozen ☐ Corrosive burden	→ Heat or drain the pump station.	1. → Drain the pump station. 2. → Preserve the pump station.
☐ Remains liquid ☐ No corrosive burden	–	–
☐ Remains liquid ☐ Corrosive burden	–	1. → Drain the pump station. 2. → Preserve the pump station.

Tab. 11: 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 22.

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	☐ Visual inspection ☐ Acoustic inspection	4 weeks
Pump station (reversing valve)	☐ Change of the active pump line	4 weeks
Strainer	☐ Visual inspection ☐ If required, clean	4 weeks
Filter/strainer with magnetic separator	☐ Cleaning the magnetic separator	Depending on the pumped liquid
Magnetic coupling	☐ Checking the tightening torques ☐ Checking the inside of the containment can for wear/ scoring ☐ Check for accumulated iron particles on the inner rotor ☐ Check for accumulated iron particles on the outer rotor	1 year
Overflow valve	☐ Operation, Page 22 functional test	≤ 5 years

Tab. 12: Required maintenance

11.3 Ball bearing

When using the pump in lubrication oil applications with a minimum purity class of 21/18/13 according to ISO 4406, a bearings replacement at the latest after 5 years (40000 h) is sufficient.

11.4 Maintaining the pump station

Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

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 35.
4. Observe the additional operating instructions of optional components.

11.5 Maintaining the strainers

Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

1. Check the strainers visually and acoustically every four weeks.
2. In the case of a clear pressure drop clean the strainers Servicing, Page 35.

11.6 Maintaining the magnetic coupling

Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots ☐ Face protection

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.

⚠ WARNING

Hot surface.

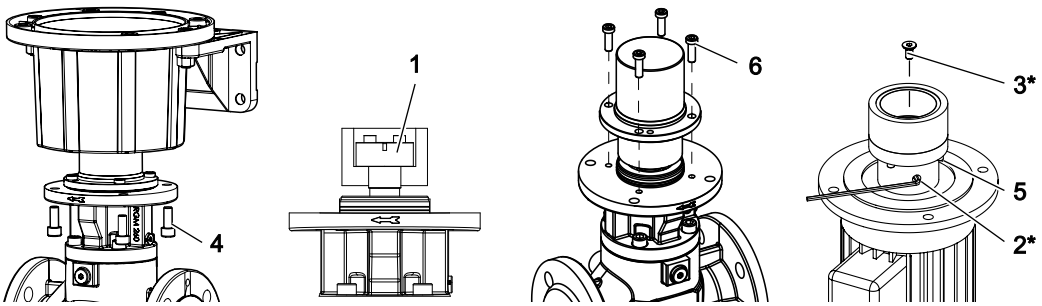
Components of the magnetic coupling heat up more than the pump during operation. Touching the magnetic coupling will result in burns.

► Before working on the magnetic coupling, allow the pump including the magnetic coupling to cool down to ambient temperature.

► Wear personal protective equipment at all times during operation. Be sure to wear protective gloves.

1. Check tightening torques of parts of the magnetic coupling annually in accordance with the table below. See also replacing the magnetic coupling Servicing, Page 35, tightening torques to be observed Appendix, Page 61.
2. Carefully clean outer surfaces of the inner rotor, outer rotor and containment can from metallic solids and other adherences Servicing, Page 35.
3. Check axial play of the ball bearing through manual movement of the shaft, see below. Replace in case of an noticeable play of more than 0.5 mm ball bearing Servicing, Page 35.

Check tightening torques

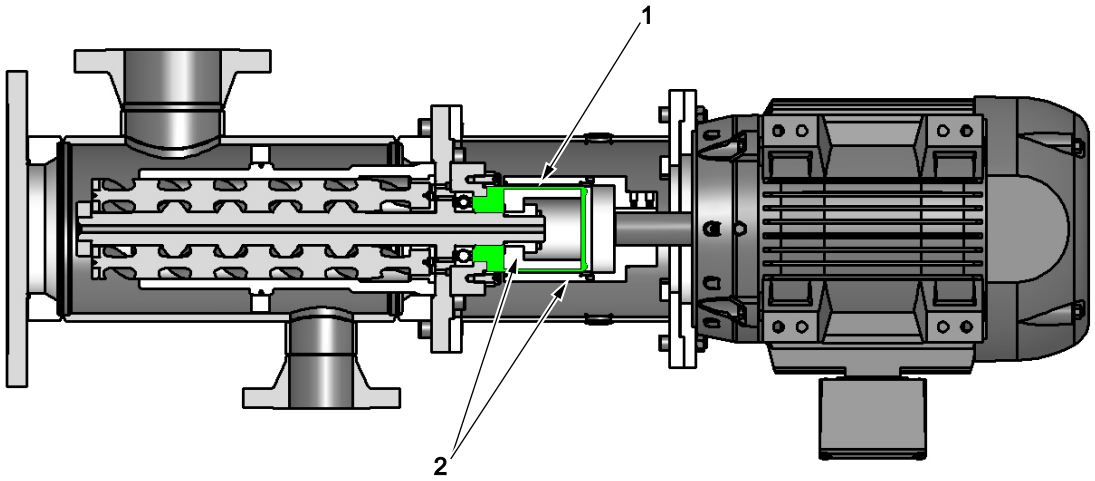


Item No.	Part
1	Tensioning element

Item No.	Part
2*	Threaded pin outer rotor support
3*	Countersunk screw outer rotor support
4	Socket screws pump bracket – pump
5	Socket screws outer rotor support – outer rotor
6	Socket screws containment can – pump
*	Depending on motor size

Tab. 13: Magnetic coupling: Parts to be maintained

Check inner rotor, outer rotor and containment can



1. Check containment can (green) **1** inside and outside for scratches, scores or other damage.
2. Check the inner rotor and the inside of the outer rotor **2** for cleanliness (no particles or chips ....) and damage.
3. Clean all surfaces completely of solids or ferrous build-up, see below.

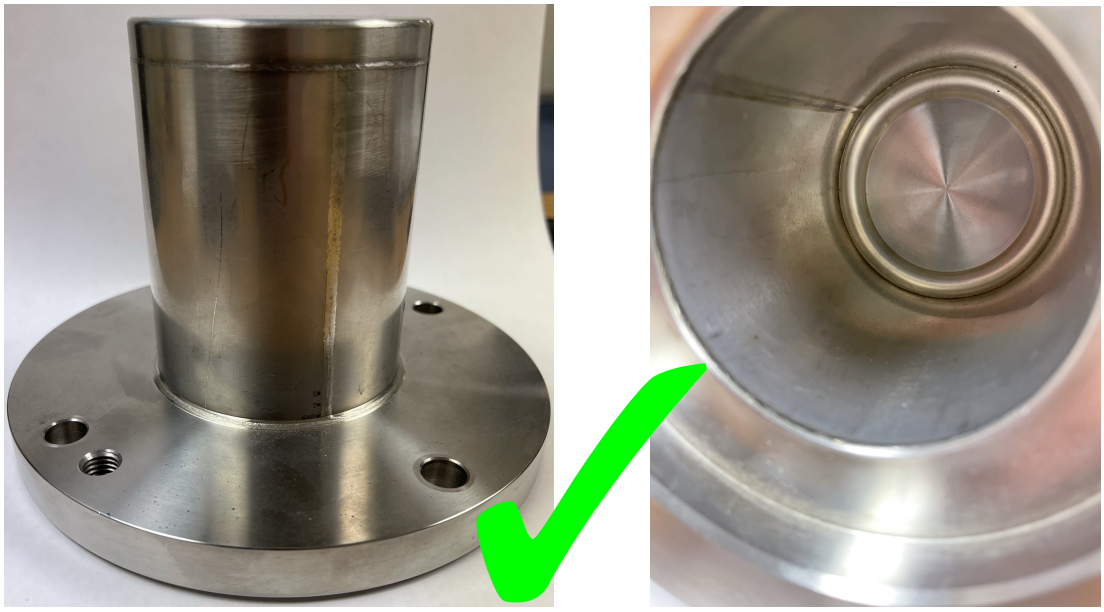


Fig. 15: Containment can
Left: Outer surface free from grooves
Right: Inside free from grooves

Fig. 16: Containment can
Left: Groove extends over the entire wall thickness
Right: several deep grooves in succession

4. Containment can
   Check the condition of the can, especially the inside.
   ⇨ If the grooves are deeper than 0.5 mm, the containment can must be replaced, as the compressive strength of the thin-walled containment can may be considerably reduced.

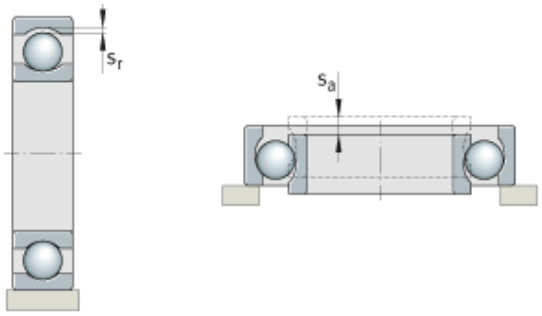
Fig. 17: Inner rotor
Left: Inner rotor without adhesions
Right: Large amount of iron particles accumulated on the inner rotor

5. Inner rotor
   If iron particles adhere to the surface, degrease the inner rotor with a solvent (acetone) and compressed air to remove the particles. Wipe off any remaining particles with a clean cloth over the edge of the inner rotor.

Check ball bearing

Fig. 18: Bearing
Left: Worn bearing with missing cage and several rolling elements
Right; running surface of bearing inner ring with embedded deposits

1. Check the condition of the bearing for completeness of the rolling elements and their surface condition.
2. Check bearing clearance and condition of bearing cage.



s_r Radial bearing clearance
s_a Axial bearing clearance

Fig. 19: Bearing clearance

⇨ The ball bearing must be replaced when the limits of the radial and axial play (bearing clearance) are exceeded.
The limits of the radial bearing clearance for non-installed bearings are specified in DIN 620-4 or ISO 5753-1. The limits of the axial bearing clearance depend on the radial bearing clearance and the concrete installation conditions so that no generally valid limits can be specified for this.
The value of 0.5 mm specified above is an empirical value tested in practice.

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 61.
- ☐ 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.
Reduction in the delivery rate or pressure under constant operating conditions	Advanced wear of screws and housing	→ Replace the pump.
Increased pressure loss at the strainer	Soiling of the strainers	→ Clean the strainer.

Tab. 14: Signs of wear

12.2.2 Magnetic coupling

When using the pump in lubrication oil applications with a minimum purity class of 21/18/13 according to ISO 4406, an inspection at the latest after 5 years (40000 h) is sufficient.

Especially for pump systems where the containment can is exposed to an inlet pressure > 0.5 barg (14.5 psig), in combination with the risk of iron particles in the lubricating oil system and no possibility of fine filtration directly upstream of the pump, we strongly recommend an annual inspection.

Magnetic filter systems

If iron particles accumulate and deposit on the inner rotor and containment can, regular inspection and cleaning of the magnetic coupling is required. In this case, the manufacturer recommends installing a filter/strainer with magnetic separator or a similar device to catch ferrous particles upstream of the pump.

12.3 Cleaning the strainer

The frequency of cleaning the filter depends on the degree of soiling of the pumped liquid. In case of strongly soiled strainers cavitation and strong noise generation arise. The suction-side pressure gauge is used to indicate the degree of soiling.

Personnel qualification:	☐ Trained personnel
Personal protective equipment:	☐ Work clothing ☐ Face protection ☐ Protective gloves ☐ Safety boots
Aids:	☐ Collection tank ☐ Solvent

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

⚠ 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.

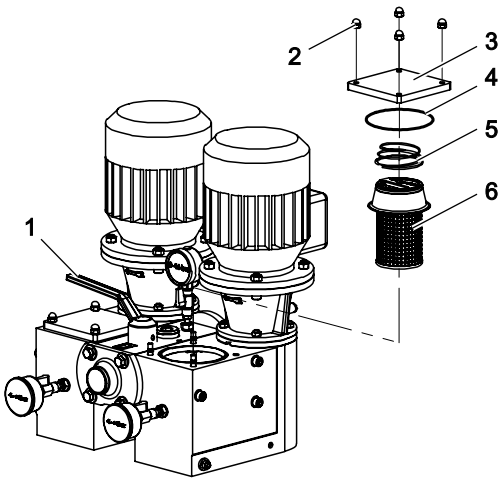
► Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.

► 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.



1. Switch over the lever of the reversing valve **1** in order to shut off the respective side ↳ During operation, Page 26.
2. Remove the cap nuts **2**, then remove the strainer cover **3** and O-ring **4**.

3. ▶ Remove the conical spring **5** and the strainer insert **6** from the strainer chamber.
4. ▶ Clean the strainer insert, for example by washing it in a solvent.
5. ▶ Reinsert the strainer insert and conical spring.
6. ▶ Place the strainer cover with O-ring and tighten with cap nuts.
7. ▶ Place the reversing valve lever in the desired position.

12.4 Replacing the magnetic coupling

12.4.1 Removing the outer rotor

Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
Aids:	☐ Open-end spanner ☐ Mounting lever ☐ Hoisting equipment ☐ Positive guide

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.

⚠ 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.

⚠ WARNING

Danger of crushing between motor and pump.

When dismantling/assembling the motor with the pump, the strong magnetic forces can cause sudden collision and therefore injuries to hands or fingers.

► Use positive guide for disassembly/assembly.
► Two people are required.
► Use suitable hoisting equipment (for example chain hoist).
► Carry out disassembly/assembly in a vertical position if possible.
► Fix the pump with suitable measures.
► When the motor is disassembled/assembled, ensure that hands/fingers are not positioned between motor and pump.

⚠ WARNING

Hot surface.

Components of the magnetic coupling heat up more than the pump during operation. Touching the magnetic coupling will result in burns.

- ► Before working on the magnetic coupling, allow the pump including the magnetic coupling to cool down to ambient temperature.
- ► Wear personal protective equipment at all times during operation. Be sure to wear protective gloves.

Requirement:

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

1. ► Switch over the reversing valve lever **1** in order to shut off the respective side ↳ During operation, Page 26

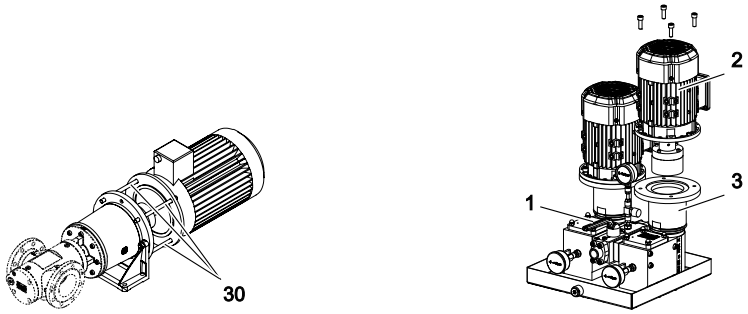
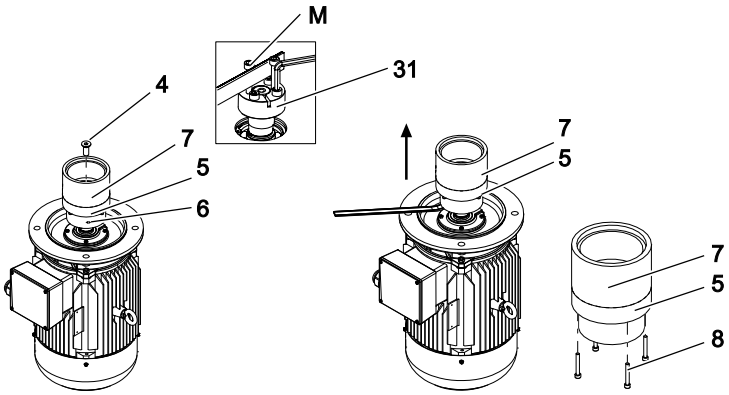


Fig. 20: Use of positive guide - priniciple diagram

2. ► Attach the hoisting equipment to the motor **2**.
3. ► Loosen cap screws between motor and pump bracket **3** and replace with positive guide **30**.
4. ► Lift the motor off the pump bracket via the positive guide.



5. ► Depending on the motor size, remove the threaded pin **6** from the outer coupling hub **5** or the countersunk screw **4** from the outer rotor **7**.
   -or-
   If outer coupling hub with clamping element is fitted: Continue with step 9.
6. ► Pull the outer coupling hub and the outer rotor off from motor shaft using mounting levers.
7. ► Remove the socket screws **8** between the outer coupling hub and the outer rotor.

Only if outer coupling hub with clamping element is fitted:

8. ► Remove the cap screws **8** and outer rotor **7**.
9. ► Screw two screws **M** into the empty threaded holes of the clamping element **31** to act as anti-twist protection. Insert a suitable anti-twist device (e.g. pry bar) between the two screws **M** to fix the clamping element.
10. ► Loosen the locking screws of the clamping element with an Allen key.
11. ► Pull the outer coupling hub **5** off the motor shaft using mounting levers.
12. ► Remove cap screws **8** from the outer coupling hub.

12.4.2 Removing the inner rotor

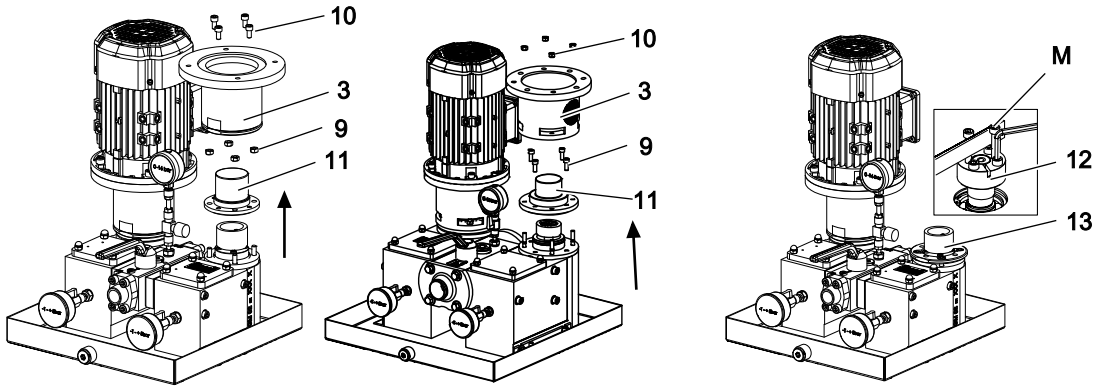
Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
Aids:	☐ Allen key ☐ Anti-rotation screw

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.



1. ▶ Depending on the size, remove the socket screws **10** or hexagon nuts **10** between the pump and pump bracket **3**, remove the pump bracket.
2. ▶ Depending on the size, remove the socket screws **9** or hexagon nuts **9** between the containment can **11** and the pump and remove the containment can.
3. ▶ To replace the inner rotor **13**, screw two screws **M** into the empty threaded holes of the tensioning element **12** as anti-rotation screws.
4. ▶ Remove the screws of the tensioning element.
5. ▶ Turn the screws back into the existing threaded holes.
   ⇨ This loosens the tensioning element from the inner rotor and from the pump shaft.

12.4.3 Installing the inner rotor

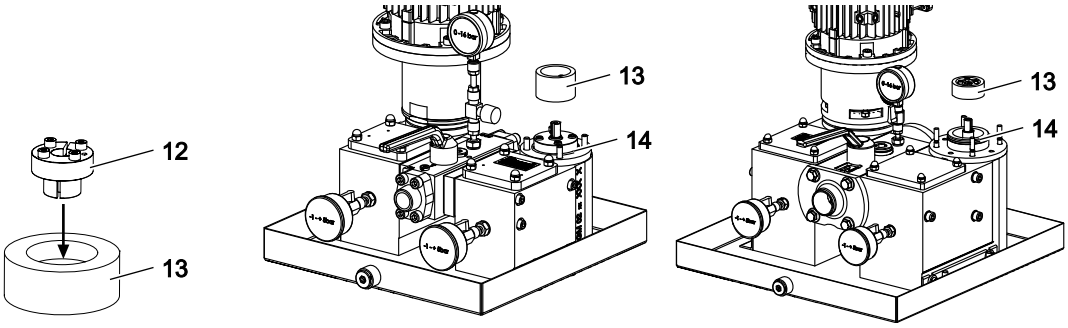
Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
Aids:	☐ Oil without molybdenum sulphide additive (e.g. multifunction spray WD-40)

⚠ DANGER

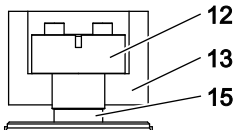
Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

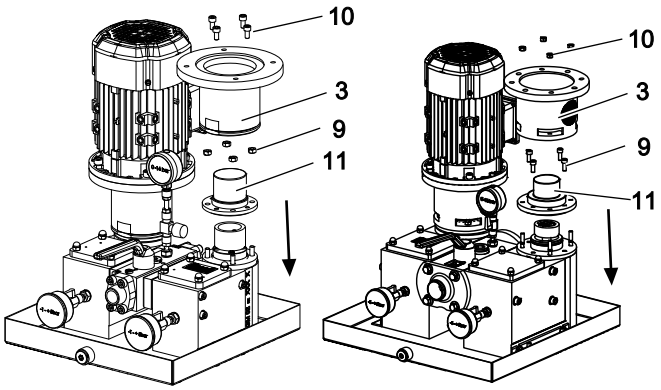
► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.



1. Carefully clean the contact surfaces of the inner rotor **13**, oil the tensioning element **12** lightly.
2. Manually turn out the screws of the tensioning element by a few turns and insert the tensioning element in the inner rotor.
3. Carefully clean the sealing surfaces.
4. Clean and lightly grease the O-ring **14** and insert the O-ring.
5. Place the inner rotor with the premounted tensioning element onto the pump shaft and tighten the screws of the tensioning element crosswise by hand.



6. Check the position of the tensioning element: The tensioning element has to lie flat on the distance sleeve **15** and inner rotor. Otherwise loosen the screws and reposition the tensioning element.
7. When the position is correct, first tighten the screws of the tensioning element with half the torque crosswise. Subsequently tighten several times crosswise with the full tightening torque ↳ Appendix, Page 61.



8. Depending on the size, press the containment can **11** onto the pump flange and tighten the socket screws **9** or hexagon nuts **9** with torque.
9. Depending on the size, place the pump bracket **3** on the pump and tighten the socket screws **10** or hexagon nuts **10** with torque.

12.4.4 Installing the outer rotor

Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
Aids:	☐ Hoisting equipment ☐ Torque wrench ☐ Positive guide

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

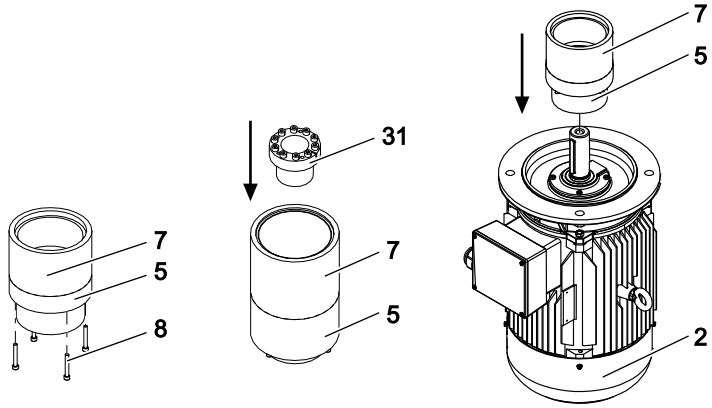
- ► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.

⚠ WARNING

Danger of crushing between motor and pump.

When dismantling/assembling the motor with the pump, the strong magnetic forces can cause sudden collision and therefore injuries to hands or fingers.

- ► Use positive guide for disassembly/assembly.
- ► Two people are required.
- ► Use suitable hoisting equipment (for example chain hoist).
- ► Carry out disassembly/assembly in a vertical position if possible.
- ► Fix the pump with suitable measures.
- ► When the motor is disassembled/assembled, ensure that hands/fingers are not positioned between motor and pump.

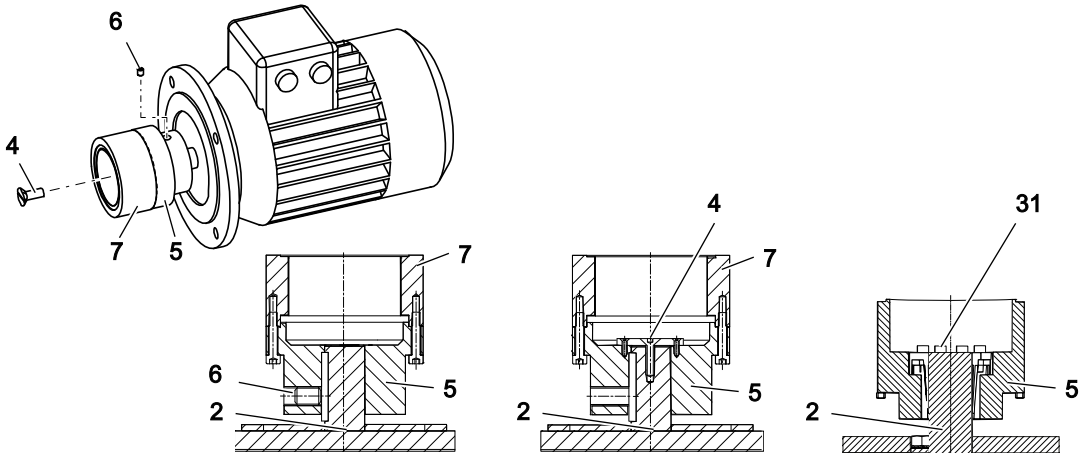


1. Clean the outer rotor **7** carefully with compressed air. Tighten the socket screws **8** between the outer rotor and outer coupling hub **5** with torque ↳ Appendix, Page 61.
2. Clean and grease the shaft end of the motor **2**.
3. Place the outer coupling hub with outer rotor on shaft end of the motor.

   -or-

   Outer coupling hub with clamping element:

   - Lightly oil the clamping element **31**.
   - Manually turn out the screws of the clamping element by a few turns and insert the clamping element in the outer coupling hub **5**.
   - Place the outer coupling hub with the premounted clamping element onto the pump shaft and tighten the screws of the clamping element crosswise by hand.



4. Ensure that the shaft end of the motor is flush with the front surface of the outer coupling hub (and clamping element).
5. Depending on the motor size tighten the threaded pin **6** on the outer coupling hub or the countersunk screw **4** on the outer rotor with torque.
   -or-
   Fix the outer coupling hub with clamping element: First tighten the screws of the clamping element **31** crosswise with half the torque. Subsequently tighten several times crosswise with the full torque.

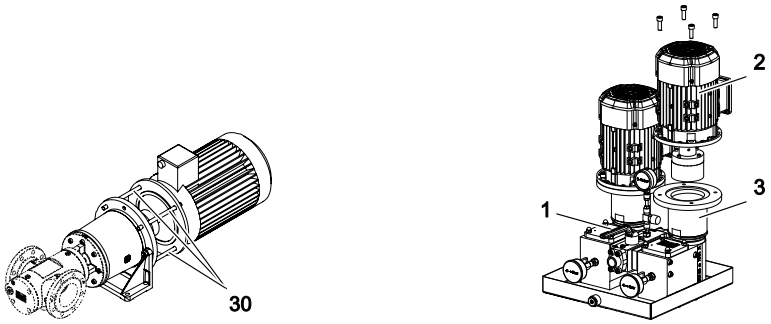


Fig. 21: Use of positive guide - priniciple diagram

6. Attach the hoisting equipment to the motor **2** and position it above the pump.
7. Insert the positive guide **30** between the motor and the pump bracket **3**.
8. Place the motor slowly on the pump bracket of the pump via the positive guide. Ensure that the outer rotor **7** does not strike the containment can.
9. Remove the positive guide.
10. Screw in the cap screws between the pump bracket and the motor and tighten them with torque.
11. Make sure that the outer rotor does not rub against the containment can by turning the fan wheel of the motor.
12. Turn changeover valve lever **1** to centre positionDuring operation, Page 26.

12.5 Replacing the pump

Personnel qualification:	☐ Fitter ☐ Electrician
Personal protective equipment:	☐ Work clothing ☐ Face protection ☐ Protective gloves
Aids:	☐ Hoisting equipment

⚠ 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.

⚠ 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.

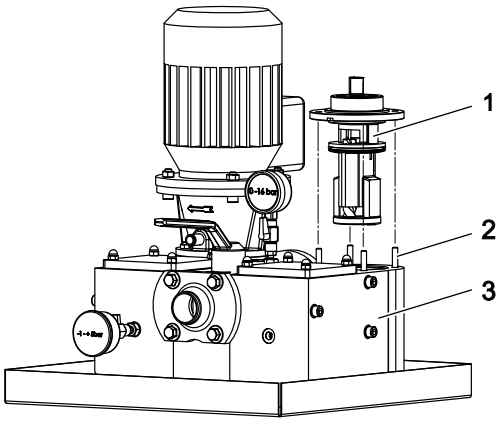
⚠ WARNING

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

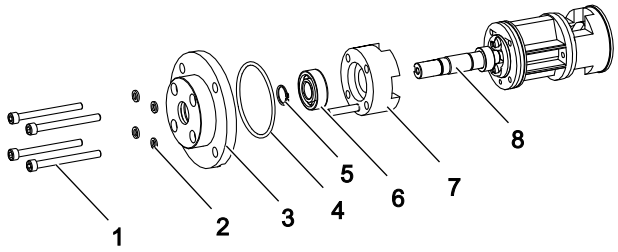


1. ► Pull the cartridge housing **1** exactly vertically via the stud screws **2** from the housing **3**.
2. ► Clean all the sealing surfaces thoroughly.
3. ► Insert the new pump into the housing via stud screws.
4. ► Installing the coupling ↳ Servicing, Page 35.

12.6 Replacing the ball bearing

Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
Aids:	☐ Extractor

Requirement:
✓ Cartridge pump removed



1. ▶ Remove the socket screws **1** and pull out the flange cover **3**.
2. ▶ Remove the circlip **5** and bearing cover **7** with the extractor from the main screw **8**.
3. ▶ Remove the ball bearing **6** from the bearing cover.
4. ▶ Clean all the sealing surfaces thoroughly and mount the new ball bearing in the reverse order.

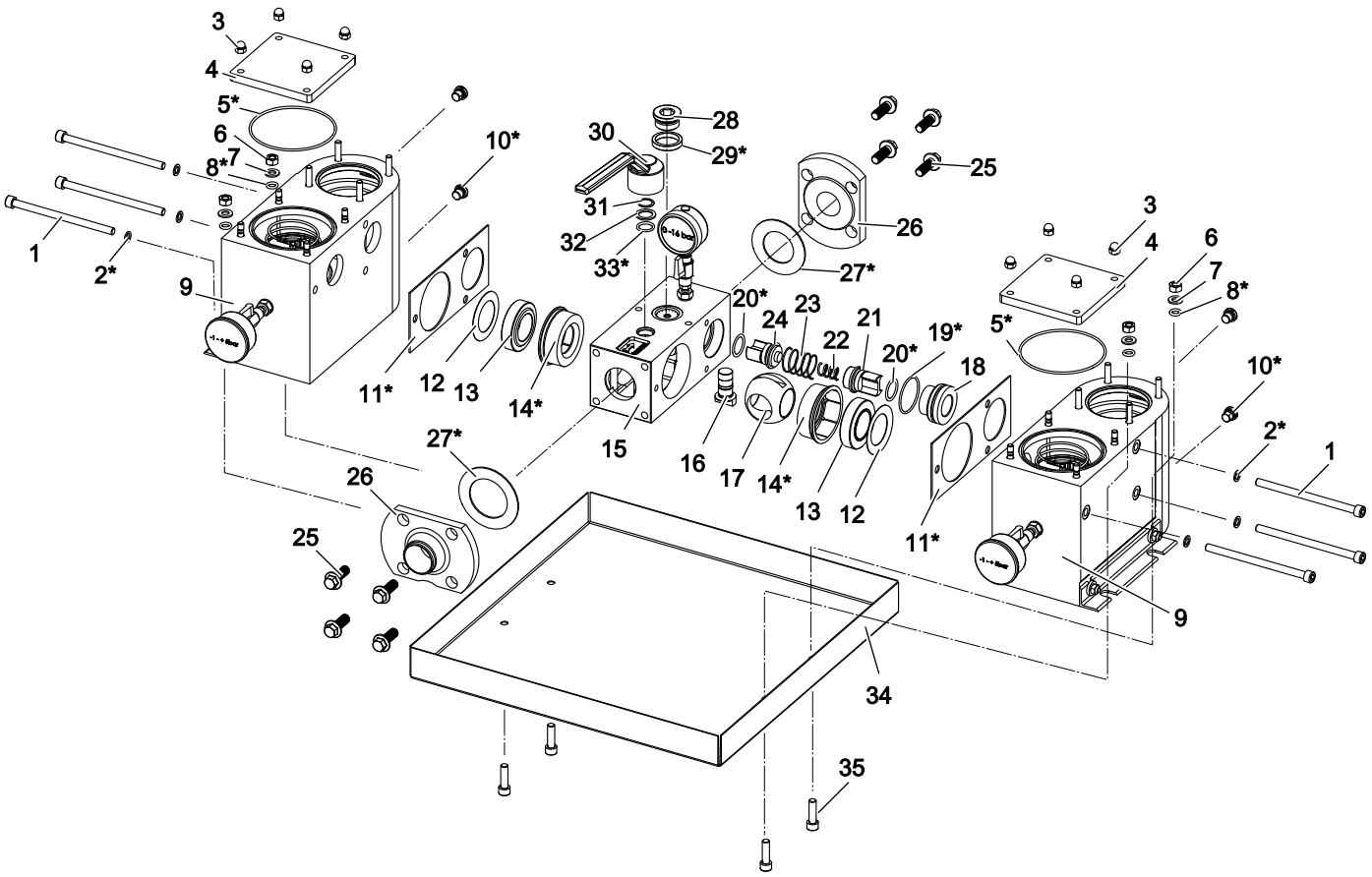
12.7 Replacing seals

12.7.1 Replacing seals (DS3/ DS4)

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

Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
Aids:	☐ Solvent ☐ Silicone grease

Requirement:
✓ Pump station removed



Dismantling the housing and control block

1. Remove the socket screws **35**, hexagon nuts **6**, washer **7** and O-ring **8*** and remove the pump station from the oil pan **34**.
2. Remove the socket screws **1** and copper seals **2*** and remove the housing **9** from the control block **15**.
3. Remove the flat gasket **11***.

Strainer: Remove the O-ring 5*

1. Remove the cap nuts **3**, strainer cover **4** and O-ring **5*** from the housing.
2. Lightly grease the new O-ring and insert it.
3. Mount the strainer cover with cap nuts with torque.

Overflow valve: Replace the seal ring 29*

1. Remove the screw plug **28** from the control block.
2. Replace the seal ring **29***.
3. Tighten the screw plug with torque.

Control block: Replace the flat gasket 27*

1. Take off the hexagon screws **25**, welding neck flange **26** and flat gasket **27***.
2. Clean the sealing surface and place on the new flat gasket.
3. Mount the welding neck flange with hexagon screws with torque.

Housing: Replacing the screw plug 10*

Replace the screw plug **10***.

Return valve: Replace the O-ring 19* and the O-ring 20*

1. Remove the valve insert **18** from the control block and O-ring **19***.
2. Lightly grease the new O-ring and push on the valve insert.
3. Remove the valve cone **21** from the control block and O-ring **20***.
4. Lightly grease the new O-ring and push on the valve cone.
5. Remove the pressure spring **22** and **23** and valve cone **24** from the control block.

6. ▶ Remove the O-ring **20*** from the valve cone **24**. Lightly grease the new O-ring and push on the valve cone.
7. ▶ Place the valve cone **24**, pressure spring **22** and **23**, valve cone **21** and valve insert **18** in the control block.

Reversing valve: Replace the molded gasket 14* and O-ring 33*

1. ▶ Set the lever of the reversing valve **30** to 45° so that the openings of the valve ball **17** are rotated by 45°.
2. ▶ Pull the plate spring **12**, valve insert **13** and molded gasket **14*** from the control block with the fingers.
3. ▶ Rotate lever of the reversing valve to the middle position and remove the valve ball.
4. ▶ Remove the reversing valve lever, circlip **31** and supporting ring **32**.
5. ▶ Press the tappet **16** towards the bottom.
6. ▶ Remove the O-ring **33** from the control block.
7. ▶ Insert the tappet **16** from the bottom and rotate in such a way that the valve ball can be inserted via the nut.
8. ▶ Insert the valve ball **17**.
9. ▶ Lightly grease the new O-ring **33***, slide over the tappet and press into the groove of the control block.
10. ▶ Mount the supporting ring **32** and circlip **31** and insert the reversing valve lever.
11. ▶ Press the new molded gaskets **14*** carefully in until they are flush with the outer surface of the control block.
12. ▶ Insert the valve insert **13** and plate spring **12**. Ensure that the bulge of the plate spring points towards the control block.

Mounting the housing and control block

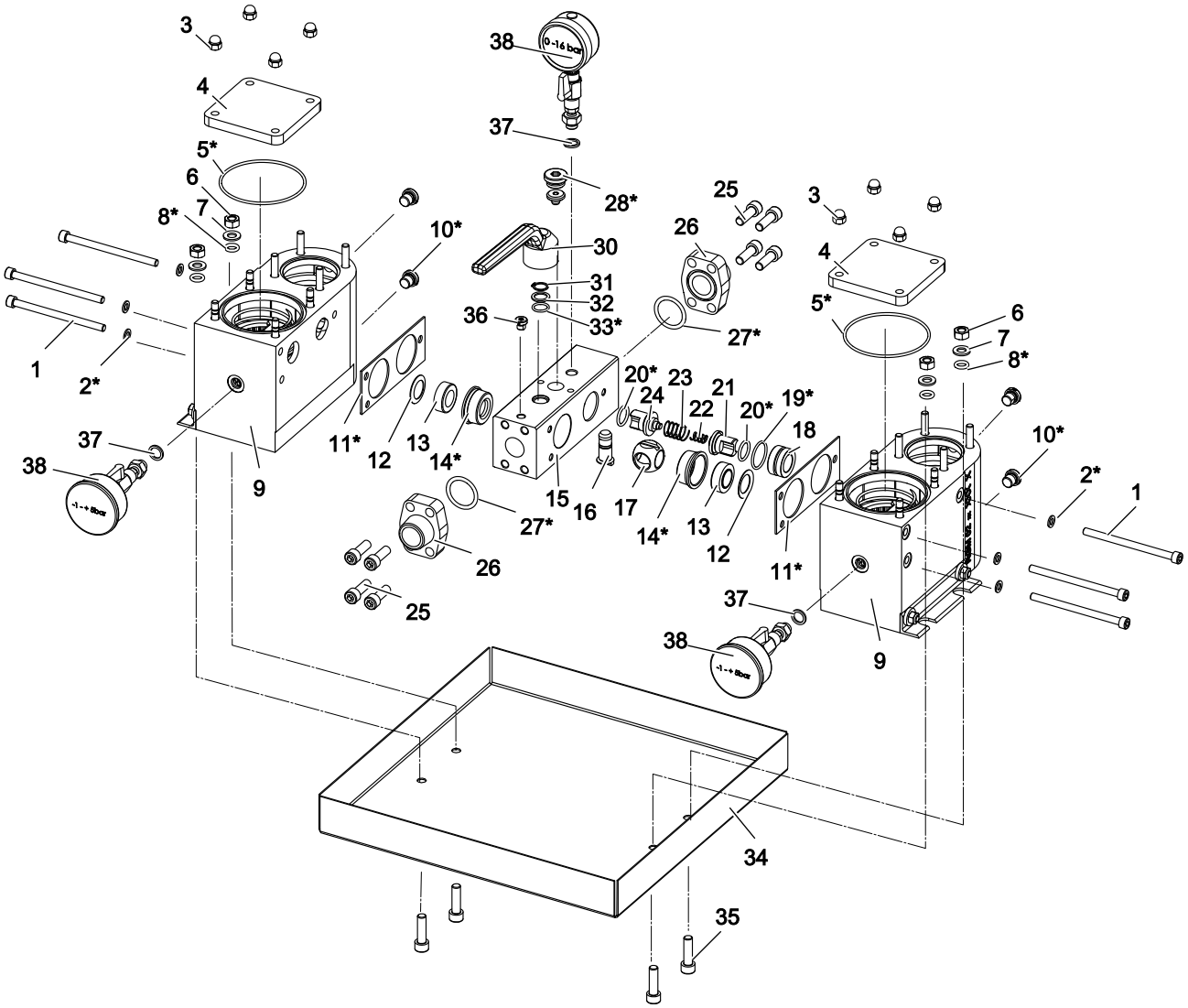
1. ▶ Clean the sealing surfaces, put a new flat gasket **11*** on the control block.
2. ▶ Mount the housing **9** at the control block with socket screws **1** and mount new copper seals **2*** and with torque.
3. ▶ Lightly grease the new O-ring **8***.
4. ▶ Mount the pump station on the oil pan with socket screws **35**, hexagon nuts **6**, washer **7** and O-ring **8*** with torque.
5. ▶ Install the pump station ↳ Installation, removal, Page 17.
6. ▶ Filling and venting the pump ↳ Commissioning, Page 22.

12.7.2 Replacing seals (DS1)

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

Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
Aids:	☐ Solvent ☐ Silicone grease

Requirement:
✓ Pump station removed



Dismantling the housing and control block

1. Remove the socket screws **35**, hexagon nut **6**, washer **7** and O-ring **8*** and remove the pump station from the oil pan **34**.
2. Remove the socket screws **1** and copper seals **2*** and remove the housing **9** from the control block **15**.
3. Remove the flat gasket **11***.

Strainer: Remove the O-ring 5*

1. Remove the cap nuts **3**, strainer cover **4** and O-ring **5** from the housing.
2. Lightly grease the new O-ring and insert it.
3. Mount the strainer cover with cap nuts with torque.

Housing: Replacing the screw plug 10*

Replace the screw plug **10***.

Overflow valve: Replacing the screw plug 28*

Replace the screw plug **28***.

Control block: Replace the screw plug 36*

Replace the screw plug **36***.

Control block: Remove the O-ring 27*

1. Take off the hexagon screws **25**, welding neck flange **26** and O-ring **27***.
2. Lightly grease the new O-ring and insert it.
3. Mounting the welding neck flange with hexagon screws with torque.

Return valve: Replace the O-ring 19* and the O-ring 20*

1. Remove the valve insert **18** from the control block and O-ring **19***.
2. Lightly grease the new O-ring and push on the valve insert.
3. Remove the valve cone **21** from the control block and O-ring **20***.
4. Lightly grease the new O-ring and push on the valve cone.
5. Remove the pressure spring **22** and **23** and valve cone **24** from the control block.
6. Remove the O-ring **20*** from the valve cone **24**. Lightly grease the new O-ring and push on the valve cone.
7. Place the valve cone **24**, pressure spring **22** and **23**, valve cone **21** and valve insert **18** in the control block.

Reversing valve: Replace the molded gasket 14* and O-ring 33*

1. Set the lever of the reversing valve **30** to 45° so that the openings of the valve ball **17** are rotated by 45°.
2. Pull the plate spring **12**, valve insert **13** and molded gasket **14*** from the control block with the fingers.
3. Rotate lever of the reversing valve to the middle position and remove the valve ball.
4. Remove the reversing valve lever, circlip **31** and supporting ring **32**.
5. Press the tappet **16** towards the bottom.
6. Remove the O-ring **33** from the control block.
7. Insert the tappet **16** from the bottom and rotate in such a way that the valve ball can be inserted via the nut.
8. Insert the valve ball **17**.
9. Lightly grease the new O-ring **33***, slide over the tappet and press into the groove of the control block.
10. Mount the supporting ring **32** and circlip **31** and insert the reversing valve lever.
11. Press the new molded gaskets **14*** carefully in until they are flush with the outer surface of the control block.
12. Insert the valve insert **13** and plate spring **12**. Ensure that the bulge of the plate spring points towards the control block.

Pressure gauge: Replace the seal ring 37*

1. Remove the pressure gauge **38**.
2. Replace the seal ring **37*** and mount the pressure gauge.

Mounting the housing and control block

1. Clean the sealing surfaces, put a new flat gasket **11*** on the control block.
2. Mount the housing **9** at the control block with socket screws **1** and mount new copper seals **2*** with torque.
3. Lightly grease the new O-ring **8***.
4. Mount the pump station on the oil pan with socket screws **35**, hexagon nuts **6**, washer **7** and O-ring **8*** with torque.
5. Install the pump station Installation, removal, Page 17.
6. Filling and venting the pump Commissioning, Page 22.

13 Disposal

13.1 Dismantling and disposing of the pump station

Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Face protection ☐ Protective gloves ☐ Safety boots
Aids:	☐ Solvents or industrial cleaners suitable for the pumped liquid ☐ Collection tank

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump station.

⚠ 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

1. ▶ Dismantle the pump station and disassemble it into its individual parts.
2. ▶ Clean residues of the pumped liquid from the individual parts.
3. ▶ Separate sealing elements made of elastomers and ceramics (SiC) from the pump station and dispose of them in separately.
4. ▶ 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	Magnetic coupling leaks

14.2 Troubleshooting

Fault identification							Cause	Remedy
1	–	–	–	–	–	–	Pump suction line closed	
								⟶ Check the shut-off devices. If required, open.
1	2	3	–	5	–	–	Parts soiled (filter, suction line, suction valve, strainer)	
								⟶ Clean parts.
1	2	3	–	5	–	–	Suction head too high	
								⟶ Reduce the level difference. -or- Reduce the line length. -or- Increase the line cross-section. -or- Heat up the pumped liquid. -or- Install a filter / strainer with a larger mesh width. Ensure that the permissible mesh width is not exceeded.
1	–	3	–	–	–	–	Level in the intake container too low	
								⟶ Fill the intake container.
1	–	–	–	–	–	–	Soiling of the filters/strainers	
								⟶ Clean the filters/strainers ↳ Servicing, Page 35.
1	–	–	–	–	–	–	Too little pumped liquid in the pump	
								⟶ Fill the pump with pumped liquid.
1	–	–	–	–	–	–	Incorrect pump direction of rotation	
								⟶ Swop the two electrical connection phases ↳ Connection, Page 20.
1	–	3	4	5	–	–	Viscosity of the pumped liquid too high	
								⟶ Increase the temperature of the pumped liquid. -or- Decrease the speed.
–	2	–	–	–	–	–	Viscosity of the pumped liquid too low	
								⟶ Reduce the temperature of the pumped liquid. -or- Increase the speed.
–	2	3	–	5	–	–	Airlock/gas in the pumped liquid	
								1. ⟶ Test the pipe system for air admission, replace leaking parts. 2. ⟶ Reduce the suction head. -or- Increase the inlet pressure.
–	2	–	4	–	–	–	Speed/frequency/voltage of the motor false	
								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	
								⟶ Contact the manufacturer.
–	–	3	–	–	–	–	Pump subject to mechanical stress	
								1. ⟶ Support the weight of the pipe system. 2. ⟶ Connect the pump station correctly to the pipe system ↳ Connection, Page 20.
–	–	3	–	–	–	–	Vibrations/pulsations in the system	
								⟶ Bear the pump station elastically. -or- Make the connections with hoses.

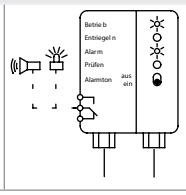
Fault identification							Cause	Remedy
–	–	3	–	–	–	–	Flow speed in the pressure line or suction line too high	
								→ Set the flow speed in the pressure line so that it does not exceed 3 m/s. -or- Set the flow speed in the suction line so that it does not exceed 1 m/s. -or- Contact the manufacturer.
–	–	3	4	–	–	7	Ball bearing damaged	
								→ Replace the ball bearing ↳ Servicing, Page 35.
–	2	3	4	–	–	7	Superficial damage to pump parts coming into contact with the liquid	
								→ Contact the manufacturer.
–	–	–	–	–	–	7	Overload due to excessive pressure build-up during the heating process	
								→ 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	
								1. → Operate pump on frequency inverter or with soft starter. 2. → Install the heating system.
–	–	3	–	–	6	–	Differential pressure is too high and has overloaded the idle screws	
								→ Contact the manufacturer.
–	–	3	–	–	6	–	Viscosity is too low and has overloaded the idle screws	
								→ Contact the manufacturer.
1	2	3	4	–	–	7	Pump damaged through dry running	
								→ Contact the manufacturer.
1	–	–	–	–	–	–	Pump does not vent	
								→ Vent the pressure line at the highest point.
1	2	3	–	–	–	–	Reversing valve lever in the incorrect position	
								→ Switch the lever of the reversing valve to the correct position ↳ During operation, Page 26.
–	2	–	–	5	–	–	Pressure maintaining valve set incorrectly	
								→ Set the pressure maintaining valve ↳ During operation, Page 26.
–	–	3	4	–	–	7	Ball bearing damaged	
								→ Replace the ball bearing ↳ Servicing, Page 35.

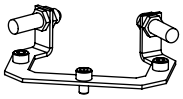
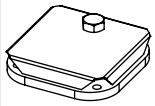
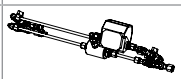
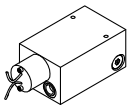
Tab. 15: Fault table

15 Accessories

15.1 Pump station accessories

Detailed information is provided in the respectively associated technical documentation.

Accessories/function		Accessories/function	
Leak oil monitoring ☐ Monitoring of the leak oil quantity in the oil pan ☐ To be used with an elevated oil pan		Temperature monitoring ☐ Monitoring of the temperature of the pumped liquid	

Accessories/function		Accessories/function	
Limit switch ☐ Remote monitoring of the lever position for switching levers		Securing of the strainer cover ☐ Controlled opening of the strainer chamber	
Differential pressure monitoring ☐ Monitoring of the differential pressure at the strainer ☐ Optical display or electrical contacts		Fluid heating system/electrical heating system ☐ At high-viscosity pumped liquids that do not flow sufficiently if not heated	

Tab. 16: Pump station accessories

15.2 Heating

15.2.1 Possible types of heating

Pump stations of the DS series can be equipped optionally with a heating system. The manufacturer recommends a heating system at high-viscosity pumped liquids that do not flow sufficiently if not heated. This can result in excessive wattage or in problems arising through cavitation or sealing.

Possible types of heating:

☐ Combined electrical heating system/fluid heating system

15.2.2 Electrical heating system/fluid heating system

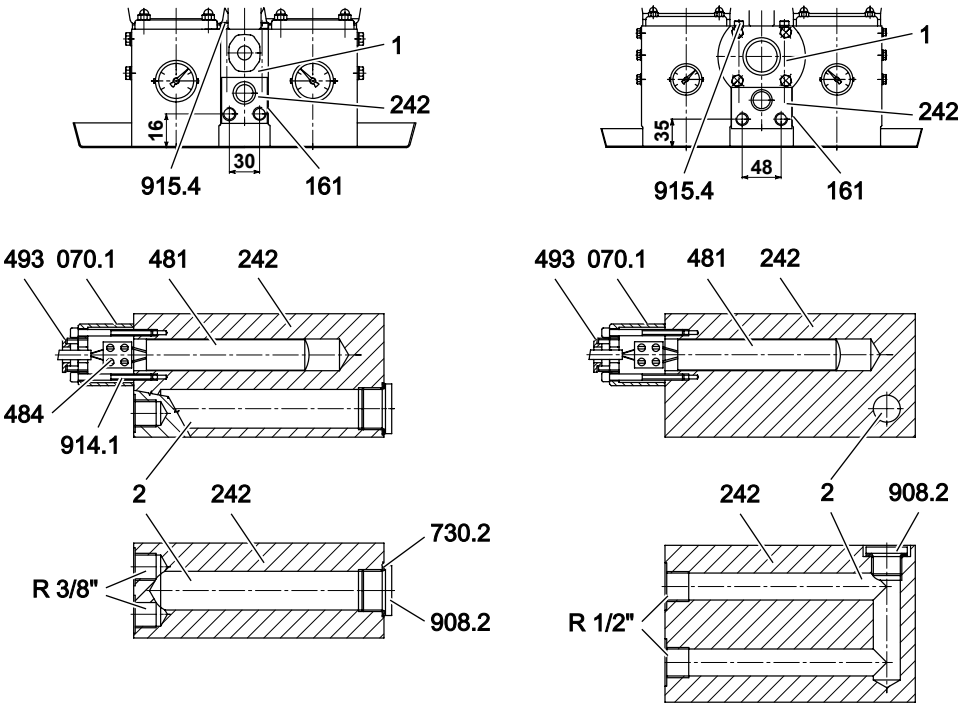


Fig. 22: Electrical heating system/fluid heating system (figure left DS1, figure right DS3, DS4)

1	Control block	**484**	Terminal strip
2	Heating duct (fluid heating system)	**493**	Screwed gland
070.1	End cover	**730.2**	Flat gasket
161	Heat conducting plate	**908.2**	Screw plug
242	Heating block	**914.1**	Socket screw
481	Heating element (electrical heating system)	**915.4**	Socket screw

The combined electrical heating system/fluid heating system consists of a heating block **242**, that is installed with socket screws **915.4** at the control block **1**. The heating takes place optionally with a heating element **481** and/or heating liquid that follows through the heating duct **2**. The heat transfer takes

place via the heat conducting plates **161**. The output of the heating element corresponds to the radiation losses and convection losses of the pump in the required temperature range so that overheating is not possible.

15.2.3 Operating data

Parameter	Unit	Series	
		DS1	DS3 / DS4
Voltage	[V]	230	
Frequency	[Hz]	50/60	
Wire cross-section	[mm²]	2 x 1	
Heating output	[W]	180	250

Tab. 17: Operating data electrical heating system

15.2.4 Heating-up period

Electrical heating system

Required heating-up period for temperature differences of 20 °C or 50 °C:

Series	Wattage	Heating-up period [min] at a temperature difference of	
	[W]	20 °C	50 °C
DS1	1 x 180	60	180
DS3, DS4	1 x 250	120	240

Tab. 18: Heating-up period for electric heating system

Fluid heating system

Required heating-up period for temperature differences of 20 °C or 50 °C at liquid temperature of 180 °C and a pressure of the water of 15 bar:

Series	Steam amount	Heating-up period [min] at a temperature difference of	
	[kg/h]	20 °C	50 °C
DS1	5	30	100
DS3, DS4	5	40	120

Tab. 19: Heating-up period for fluid heating system

15.2.5 Storing heating elements

1. Store the heating element in an absolutely dry room or in hermetically sealed plastic bags.
2. If the heating element has absorbed humidity, dry it for eight hours in a drying furnace at 180 °C.

15.2.6 Commissioning the electrical heating system

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.

⚠ DANGER

Risk of injury through discharging pumped liquid.

The pump housing may burst through heat expansion of the pumped liquid.

► Open all the valves during the heating process.

1. Switch on the electric heating system.
2. Take the required heating-up periods into account ↳ Accessories, Page 52.

15.2.7 Commissioning the fluid heating system

⚠ DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.

⚠ DANGER

Risk of injury through discharging pumped liquid.

The pump housing may burst through heat expansion of the pumped liquid.

► Open all the valves during the heating process.

1. ▶ Take the required heating-up periods into account ↳ Accessories, Page 52.
2. ▶ When setting the pressure and temperature of the heating fluid take the permissible operating limits of the pump into account ↳ Technical data, Page 9.

16 Spare parts

16.1 Overview

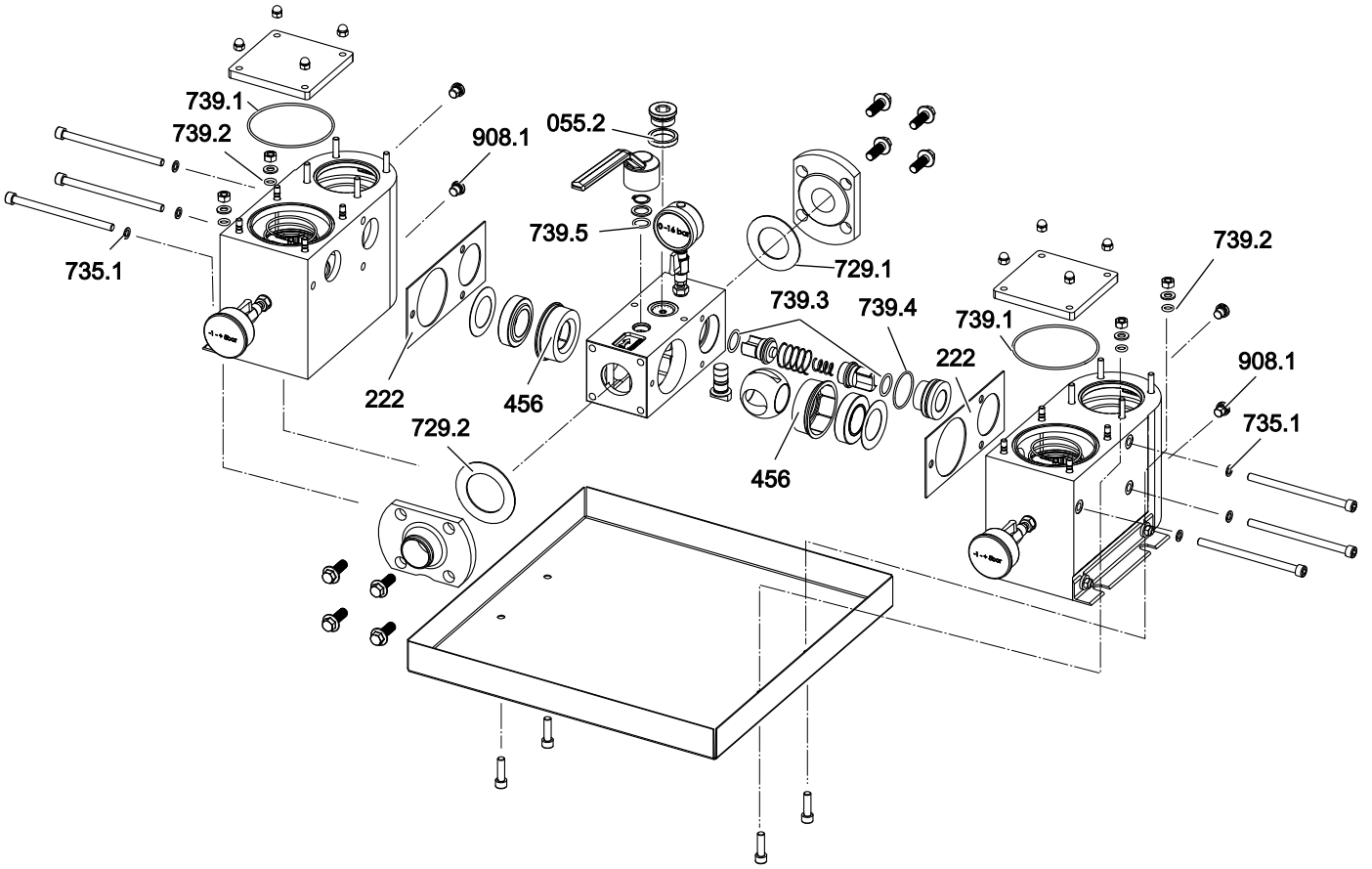
Model/Size	Type	Variant
DS3/DS4	Gasket set	Pump station
DS1	Gasket kit	Pump station
DS3/DS4, DS1	Repair kit	Overflow valve
DS3/DS4, DS1	Repair kit	Return valve

Tab. 20: Overview of spare parts

16.2 Gasket kits

16.2.1 Pump station seal kit (DS3/DS4)

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

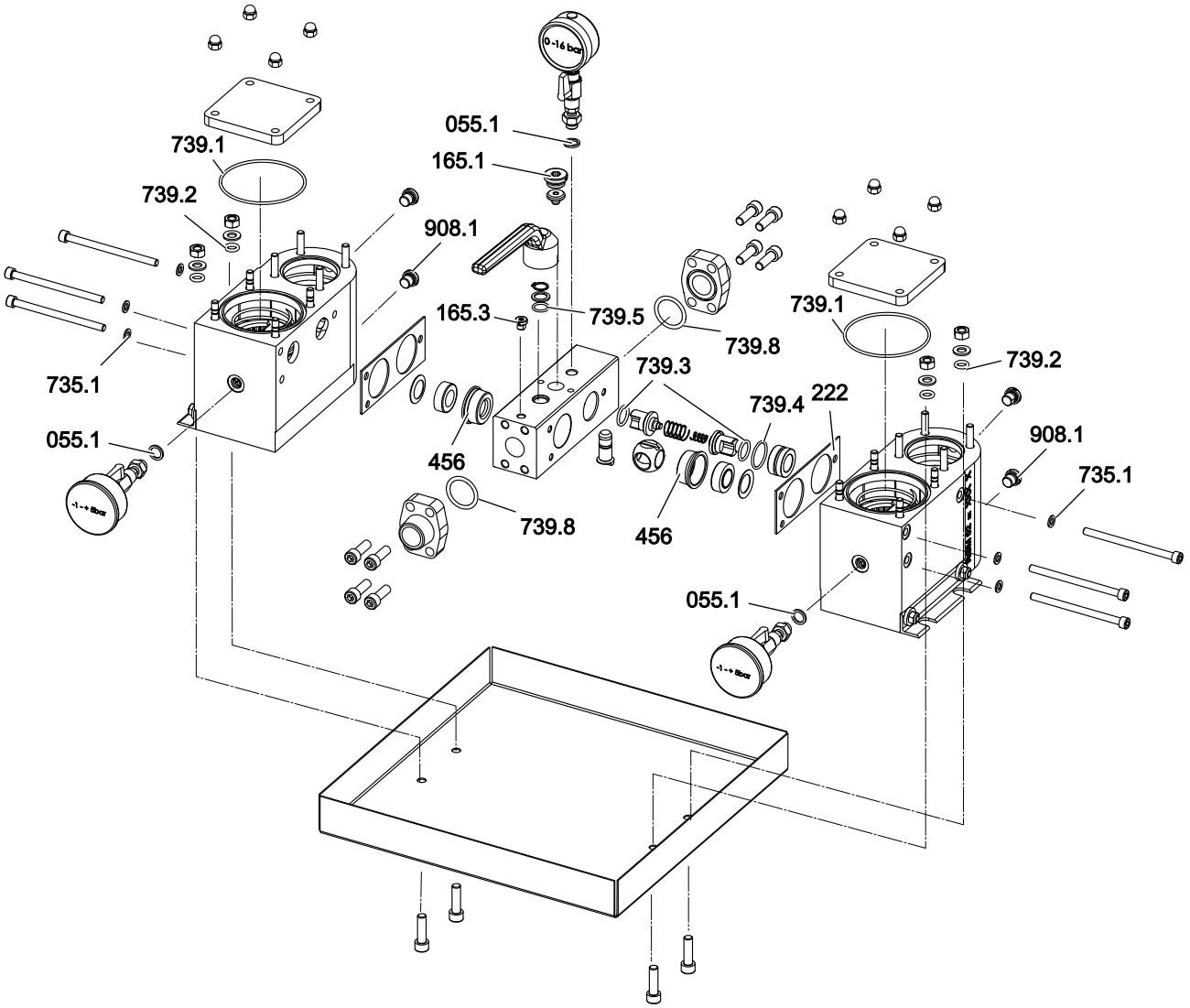


Qty.	Item no.	Part
1	**055.2**	Seal ring
2	**222**	Flat gasket
2	**456**	Moulded gasket
1	**729.1**	Flat gasket
1	**729.2**	Flat gasket
6	**735.1**	Copper seal
2	**739.1**	O-ring
4	**739.2**	O-ring
2	**739.3**	O-ring
1	**739.4**	O-ring
1	**739.5**	O-ring
4	**908.1**	Screw plug

Tab. 21: Pump station seal kit (DS3/DS4)

16.2.2 Gasket kit pump station (DS1)

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



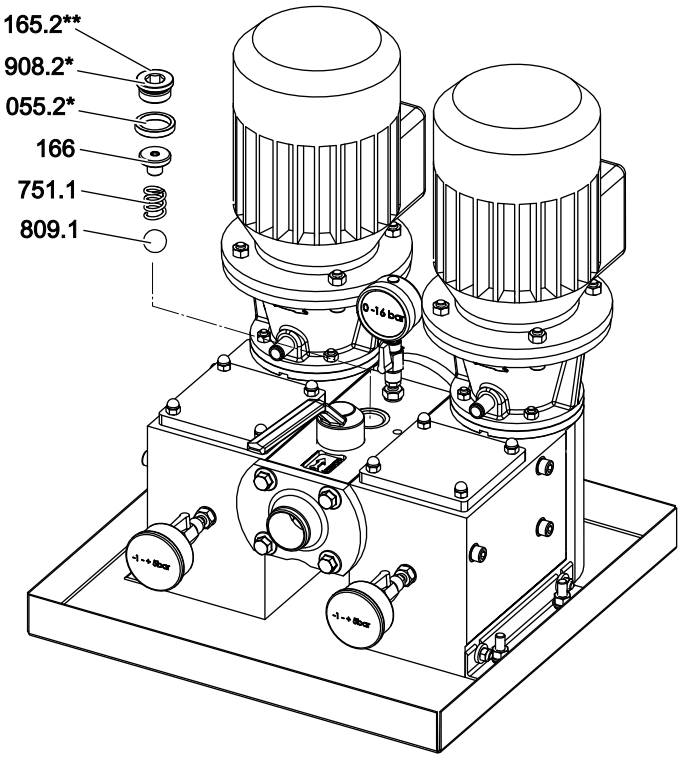
Qty.	Item No.	Part
1	**055.1**	Seal ring
1	**165.1**	Screw plug
1	**165.2**	Screw plug
1	**165.3**	Screw plug
2	**222**	Flat gasket
2	**456**	Molded gasket
6	**735.1**	Copper seal
2	**739.1**	O-ring
4	**739.2**	O-ring
2	**739.3**	O-ring
1	**739.4**	O-ring
1	**739.5**	O-ring
2	**739.8**	O-ring
2	**908.1**	Screw plug

Tab. 22: Gasket kit pump station (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.

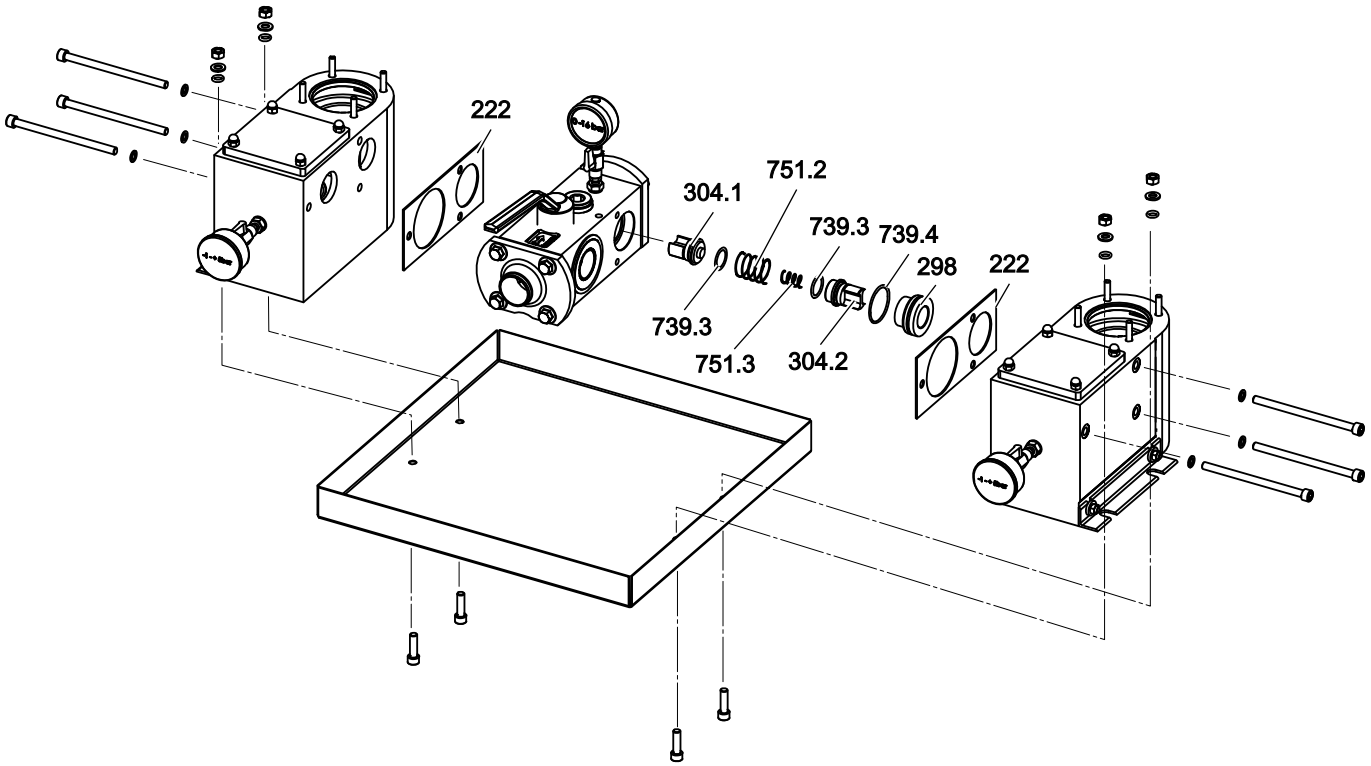


Qty.	Item no.	Part
1	**055.2***	Seal ring
1	**165.2****	Screw plug
1	**166**	Adjusting screw
1	**751.1**	Pressure spring
1	**809.1**	Ball
1	**908.2***	Screw plug
	*	Only for DS3/4
	**	Only for DS1

Tab. 23: 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.

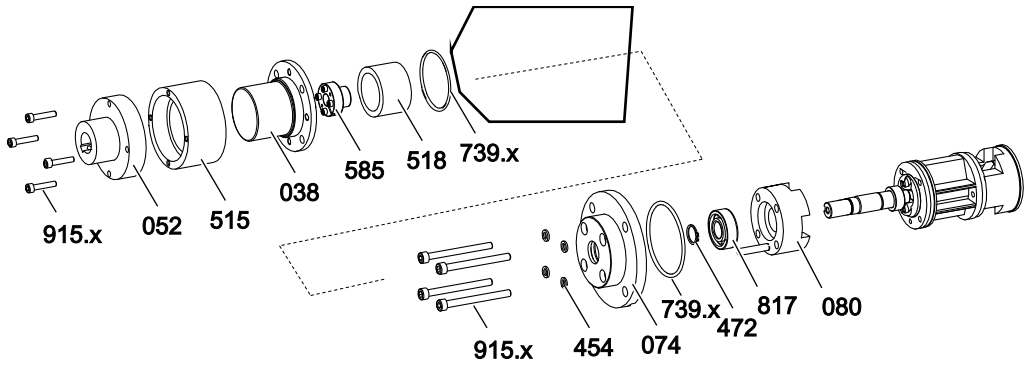


Qty.	Item No.	Part
2	**222**	Flat gasket
1	**298**	Valve insert
1	**304.1**	Valve cone
1	**304.2**	Valve cone
2	**739.3**	O-ring
1	**739.4**	O-ring
1	**751.2**	Pressure spring
1	**751.3**	Pressure spring

Tab. 24: Repair kit non-return valve

16.4 Other spare parts

16.4.1 Overview pump and magnetic coupling



Qty.	Item No.	Part
1	**038**	Containment can
1	**052**	Outer rotor support
1	**074**	Flange cover
1	**080**	Bearing cover
1	**454**	Edge sealing ring
1	**472**	Circlip
1	**515**	Outer rotor
1	**518**	Inner rotor
1	**585**	Tensioning element
1	**739.x**	O-ring
1	**739.x**	O-ring
1	**817**	Ball bearing
4	**915.x**	Socket screws
4	**915.x**	Socket screws

Tab. 25: Spare parts

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
					Stainless steel screws A2 and A4		
Thread	5.6	8.8	10.9	8.8+ Alu*	Property class 70	Property class 80	8.8
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. 26: 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. 27: 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. 28: Directives observed

KRAL

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