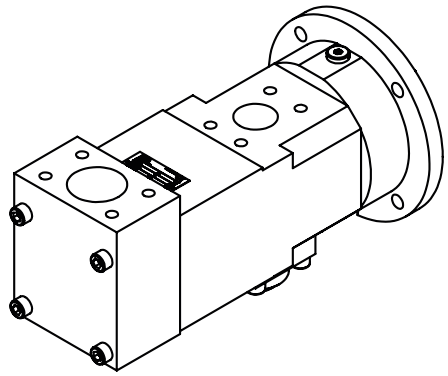
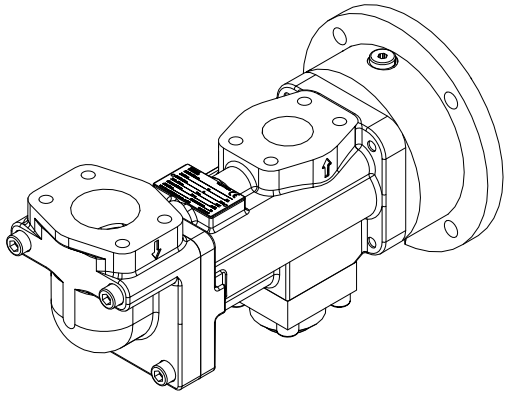
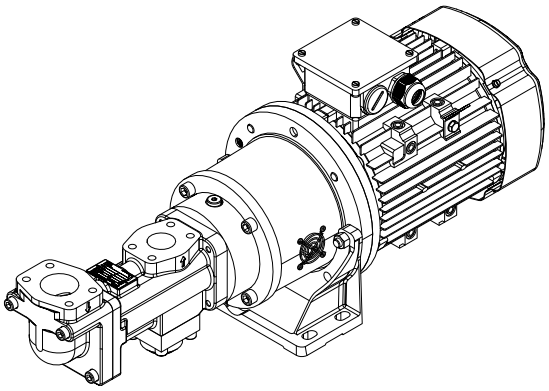
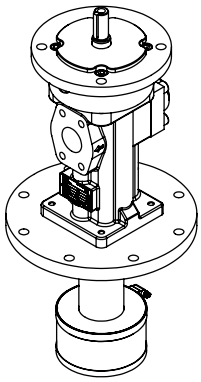
Operating instructions









KRAL screw pumps.

G series

Magnetic coupling

OIG 03en-GB
Edition 2025-04
Original instructions

Table of contents

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
- ☐ Data sheet of the pump
- ☐ Technical documentation of the supplied components

Additional documents for ATEX version

- ☐ Declaration of conformity according to EU Directive 2014/34/EU
- ☐ ATEX supplementary instructions for usage in potentially explosive areas

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

2 Safety

2.1 Proper use

- ☐ Use the pump solely for transporting lubricating liquids that are chemically neutral and that do not contain gas or solid components.
- ☐ Use the pump 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 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 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 immediately. Replace the components or pump.

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

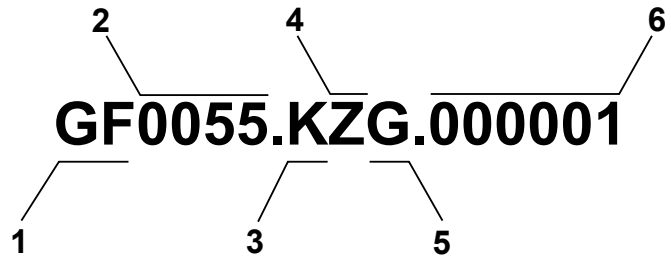


Fig. 1: Type code

Item	Classification	Description	
1	Type	GF	☐ **Pump with free shaft end** ☐ Pump unit for flange mounting
		GH	☐ Pump with free shaft end and foot ☐ Pump unit on base frame for foot motor
		GT	☐ Pump with free shaft end for tank installation ☐ Pump unit for tank installation, pressure connection via tank cap
2	Size		Corresponds to delivery rate in [l/min] at 1450 min^{-1}
3	Shaft seal	B	Mechanical seal of hard material
		C	Standard radial shaft seal
		D	Magnetic coupling
		H	Mechanical seal balanced
		K	**Mechanical seal (elastomer bellows seal), max. pressure on the seal = 6.0 bar**
		N	Mechanical seal according to API 682
		Z	Without shaft seal
		X	Special seal
4	Overflow valve	A	With overflow valve xxbar (necessity is still being checked)
		B	With overflow valve from pressure stage 2 - 25 bar (STANDARD)
		Z	**Without overflow valve**
		X	Special design
5	Pump housing material	G	Casting
		S	Steel
6	Version index	For internal administration	

Tab. 2: Type code

3.2 Rating plate

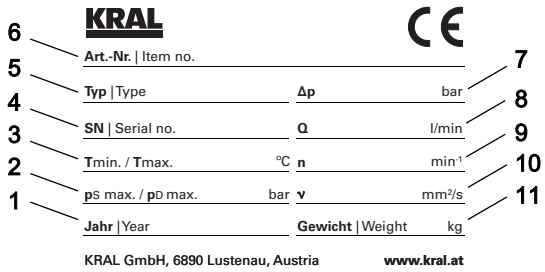


Fig. 2: Rating plate

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 Operating limits

Parameter	Unit	Size 15 – 20	32 – 42	55 – 85	105 – 118	160 – 210	235 – 275
Max. differential pressure	[bar]	23					
Max. DS allowable working pressure	[bar]	25					
Max. temperature of the pumped liquid							
☐ Magnetic coupling	[°C]	180					
☐ High-temperature magnetic coupling	[°C]	250					
Ambient temperature min. - max.	[°C]	-20 ... 50					
Viscosity min.- max.	[mm²/s]	10 – 500					
Max. speed							
☐ At 50 Hz							
☐ 2-pole	[min-1]	2900*					
☐ 4-pole	[min-1]	1450*					
☐ At 60 Hz							
☐ 2-pole	[min-1]	3500*					
☐ 4-pole	[min-1]	1750*					
Max. inlet pressure							
☐ Magnetic coupling	[bar]	16**					

Tab. 3: Operating limits

* Higher speed possible, contact manufacturer.

** Higher values on request, depending on the size of the magnetic coupling

4.2 Limit values for tank installation

In the case of vertical installation with drawing in of the pumped liquid from a tank the following limit values of the liquid level have to be observed.

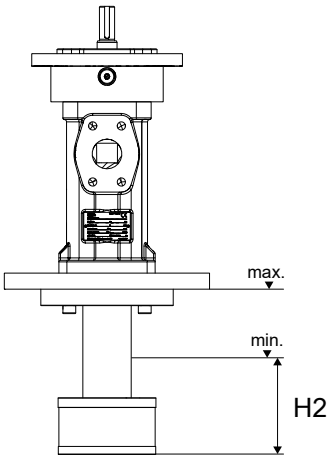


Fig. 3: Minimum/maximum liquid level

Size	Limit [mm] H2
15 – 20	148
32 – 42	168
45 – 85	202
105 – 210	244
235 – 275	290

Tab. 4: Liquid level in tank

4.3 Required NPSH values

The required NPSH values of the pump depend on the size, the viscosity of the pumped liquid and the speed.

The NPSH values are available on the website of the manufacturer:

www.kral.at/en/screw-pumps

4.4 Sound pressure level

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

	Size					
	15 – 20	32 – 42	55 – 85	105 – 118	160 – 210	235 – 275
	Max. sound pressure level ±3 [dB(A)]					
Pump	56.0	59.0	65.0	65.0	71.0	71.0
Motor	65.0	66.0	77.0	77.0	79.0	79.0
Pump unit	66.0	67.0	78.0	78.0	80.0	80.0

Tab. 5: Sound pressure level

4.5 Weights

The weight is specified on the rating plate.

5 Function description

5.1 Pump structure

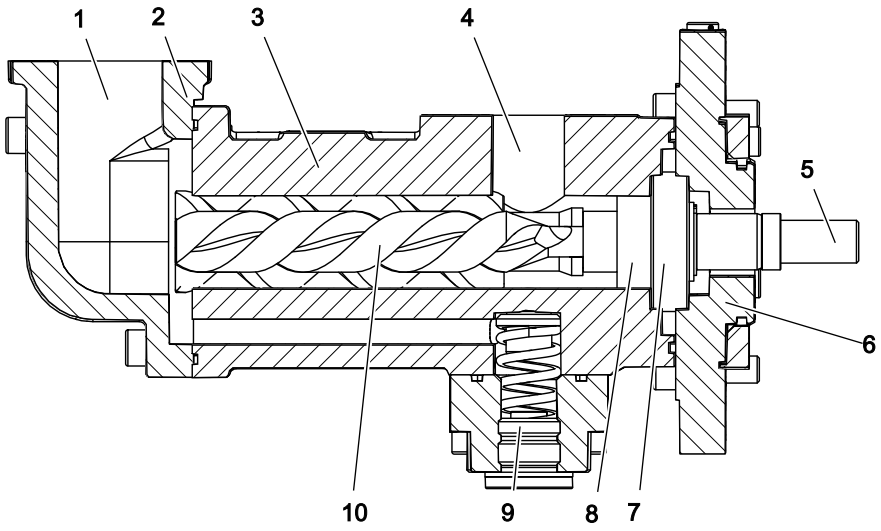


Fig. 4: Pump structure

1	Suction side	**6**	Flange cover
2	Suction cover	**7**	Ball bearing
3	Pump housing	**8**	Balancing cylinder
4	Pressure side	**9**	Overflow valve (optional)
5	Main screw	**10**	Idle screw

5.2 Pump unit structure

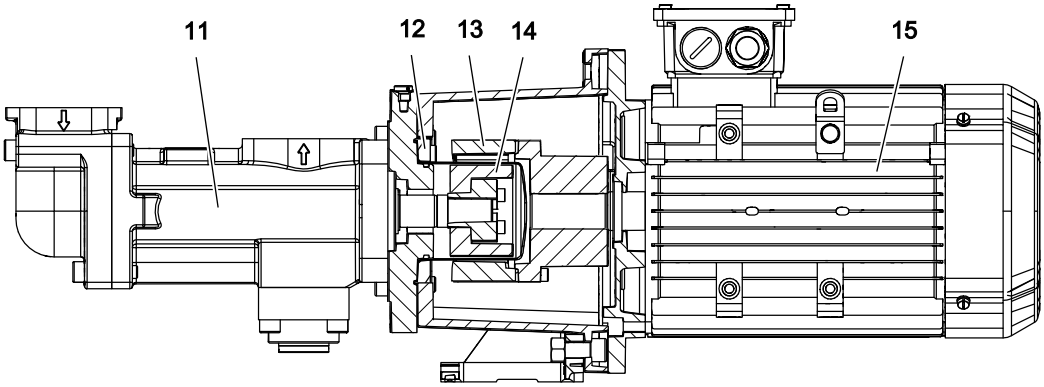


Fig. 5: Pump unit structure - principle diagram

11	Pump	**14**	Inner rotor
12	Containment can	**15**	Motor
13	Outer rotor		

5.3 Functional principle

Screw pumps are rotating displacement pumps. The displacement effect results from three rotating screws **5** and **10** and the enclosing pump housing **3**.

Radial support of the screw set is provided through the sliding contact in the pump 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.

Axial support of the main screw is effected by a deep-groove ball bearing **7**. In order to reduce the pressure, a balancing cylinder is mounted at the main screw. An integrated overflow valve **9** protects against excessive pressure that could cause housing parts to burst.

The default direction of the rotation of the screw set is clockwise viewed from the motor **15** and is marked on the pump flange **6** by an arrow.

5.4 Modular design

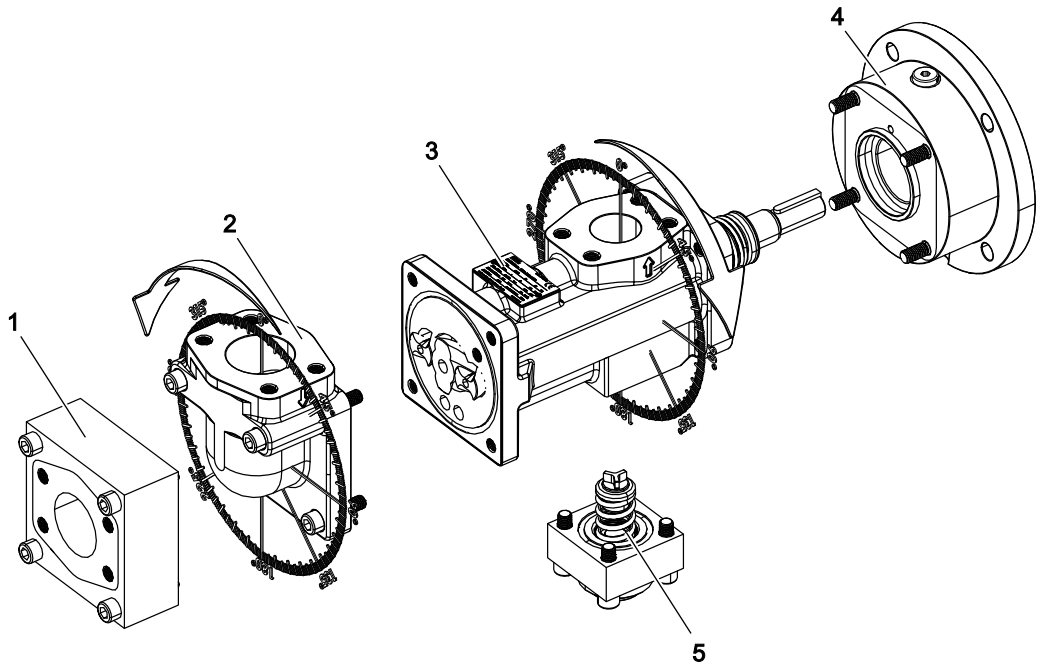


Fig. 6: Modular design

1	Axial suction cover	**4**	Flange cover
2	Radial suction cover	**5**	Overflow valve
3	Pump housing		

- ☐ Pump housing, suction cover and flange cover can each be rotated in 90° steps
- ☐ Suction cover with radial or axial inlet
- ☐ Horizontal or vertical installation option
- ☐ Immersion version or dry version

5.5 Magnetic coupling

The shaft end of the pump **11** is enclosed by a containment can **12** 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 the torque from the motor to the pump. The inner rotor **14** is fixed at the shaft end and driven by the outer rotor **13**, which in turn is fixed to the shaft of the motor **15**. 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.

5.6 Overflow valve (optional)

Note
- ☐ The protection of the pump must be ensured either through an integrated overflow valve or through an overflow valve/safety valve installed on the system side. The overflow valve/safety valve must be installed pressure-side between the pump and the first shut-off valve.
- ☐ Observe the associated operating instructions and dimensioning sheet of the pump to set an overflow valve/safety valve installed on the system side.

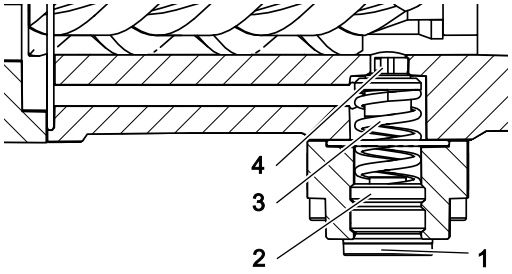


Fig. 7: Overflow valve

1	Screw plug
2	Adjusting screw
3	Pressure spring
4	Valve body

The integrated overflow valve 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 pump 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 through a safety valve at the system that the maximum operating pressure always lies under the opening pressure of the overflow valve.

Note The opening pressure of the overflow valve is set at the factory to at least 1 bar or 110 % of the differential pressure.

The overflow valve is accessible through a screw plug **1** and can be adjusted from the outside ↳ During operation, Page 25.

Note
- ☐ A function test of the overflow valve at least every 5 years is essential for the safe operation ↳ During operation, Page 25.
- ☐ 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.

6 Transportation, storage

6.1 Dangers during transportation

The following safety instructions must be observed:

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

6.2 Dangers during storage

The following safety instructions must be observed:

- ☐ Observe the storage conditions.

6.3 Unpacking and checking the state of delivery

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/pump unit.

1. Upon delivery check the pump/pump unit 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/pump unit

Personnel qualification:	☐ Transport personnel
Personal protective equipment:	☐ Protective helmet ☐ 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/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.
- ► In the case of vertical transportation secure the motor against tippling.
- ► Do not stand under raised loads.

ATTENTION

Damage to equipment through improper transportation.

- ► Protect the pump against damage, heat, sunlight, dust and moisture.

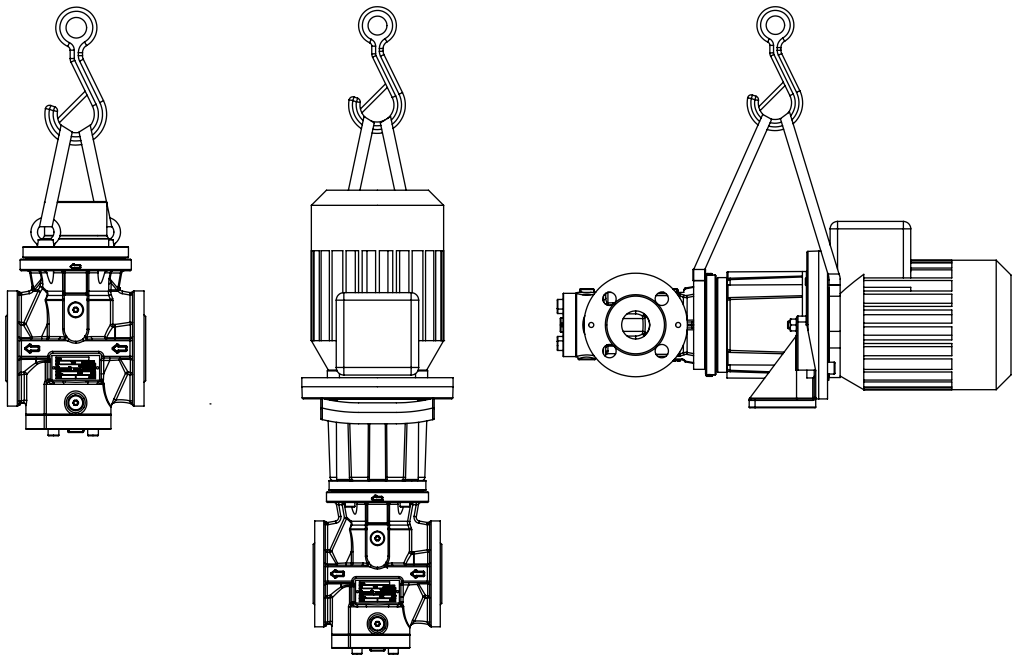


Fig. 8: Fastening of hoisting equipment - principle diagrams

1. ▶ Attach the hoisting equipment to the pump/pump unit and tighten. Ensure that the centre of gravity lies exactly under the crane hook.
2. ▶ Lift the pump/pump unit carefully and put it down shock-free.
3. ▶ Before loosening the transport belts ensure that the pump/pump unit is secured against tilting.

6.5 Storing the pump

During the test run, the internal components of the pump are wetted with test oil, which has a preservative effect. Pressure connection and suction connection are closed with protective caps. Unless otherwise specified, the outer surfaces of the pump are preserved with a single-coat PU-based two-component paint.

The preservative applied at the factory will protect the pump for about six weeks, if it is stored in a dry and clean location.

The manufacturer offers a long-term preservation for storage times of up to 60 months. The pump is additionally packed in hermetically sealing anti-corrosion paper.

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/pump unit.

ATTENTION

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

► Protect the pump against damage, heat, sunlight, dust and moisture.
► 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 14.

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. 6: Conditions for additional preservation

7.2 Preserving the inner surfaces

Personnel qualification:	☐ Trained personnel
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
Aids:	☐ Preservative (acid-free and resin-free oil)

⚠ 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. ▶ Open the packaging carefully. If the pump is protected additionally by anti-corrosion paper, ensure that it is not damaged.
2. ▶ Close the suction connection of the pump with a blind flange.
3. ▶ Pour the preservative into the pressure connection until it reaches approx. 2 cm under the rim, while slowly turning the main screw against the direction of rotation.
4. ▶ Close the pressure connection of the pump with a new blind flange.
5. ▶ Close the packaging carefully.
6. ▶ After about six months storage check the filling level of the preservative 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/pump unit.

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 ☐ Face protection ☐ Protective gloves ☐ Safety boots
Aids:	☐ Solvent ☐ Collection tank ☐ Steam-jet cleaning device with wax-dissolving additives

⚠ 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.

⚠ 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 with solvents, if necessary using a steam-jet cleaning device.
2. Remove the pressure-side blind flange carefully in order to reduce any pressure that may exist in the pump.
3. Drain the pump, collecting the preservative in a suitable vessel.
4. Remove the blind flange on the suction side.
5. To remove the residual preservative, flush the pump 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 47.
- ☐ Ensure that all the components can be accessed and that maintenance work can be carried out easily.

8.2 Dangers during removing

The following safety instructions must be observed strictly:

- ☐ Have all work carried out only by authorized qualified personnel.
- ☐ Before beginning work, let the pump unit 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 liquid is sufficiently large.

8.3 Installing the pump

The pumps can be operated in horizontal and vertical installation position.

Note Soiling in the pipe system impair the service life of the pump. If the pipe system is flushed using the pump during the initial commissioning, an additional commissioning filter has to be installed temporarily before the pump at the system (mesh width: 0.02 mm).

Personnel qualification:	☐ Transport personnel ☐ Fitter
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/pump unit.

⚠ WARNING

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

► Only fasten the pump on a stable load-bearing underground or stable load-bearing load support.

► Ensure that fastening elements and pipings are fastened sufficiently.

ATTENTION

Damage to motor through discharging pumped liquid.

► Do not install the pump above the motor.

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.
- ► Ensure that a commissioning filter is installed when the pipe system is flushed and cleaned using the pump.

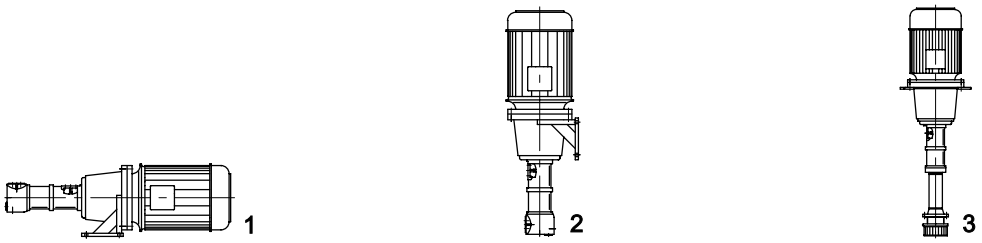


Fig. 9: Installation variants

1	Setup horizontal	**3**	Setup vertical with suction pipe and suction strainer
2	Wall mounting vertical		

Note At a vertical setup (suction operation) the manufacturer recommends the installation of a foot valve. This way the suction process is facilitated, coarse soiling is kept away and emptying of the suction line is prevented.

Requirement:

- ✓ Pump connections protected against soiling, for example by using the protective cover mounted in the factory
- ✓ If required, hoisting equipment prepared

1. ► Bring the pump in the installation position while observing the position of the motor and the flow direction, see arrow on the pump housing.
2. ► Fasten the pump with fastening elements securely on the underground.
3. ► At a vertical setup observe the minimum and maximum liquid level in the tank ↬ Technical data, Page 7.
4. ► At a vertical setup (suction operation) install a foot valve with suction strainer.

8.4 Removing the pump

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

⚠ DANGER

Risk of death resulting from electric shock.

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

⚠ DANGER

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 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 unit cool down to the ambient temperature.
► Ensure that the pump 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 unit cooled down to the ambient temperature
✓ Pump unit disconnected from the electrical power supply, deenergized and secured against being switched back on

1. Close the pressure-side and suction-side shut-off devices.
2. Empty the pump at the lowest point. Collect the discharging pumped liquid in a collection tank.
3. Dismantle the pressure-side and suction-side connecting flanges.
4. Disconnect the pump unit from the pipe system and empty it. Collect any discharging pumped liquid.
5. Screw out the fastening elements used to fasten the pump.
6. Dismantle the pump unit on site or transport it to a suitable location ↳ Transportation, storage, Page 12.

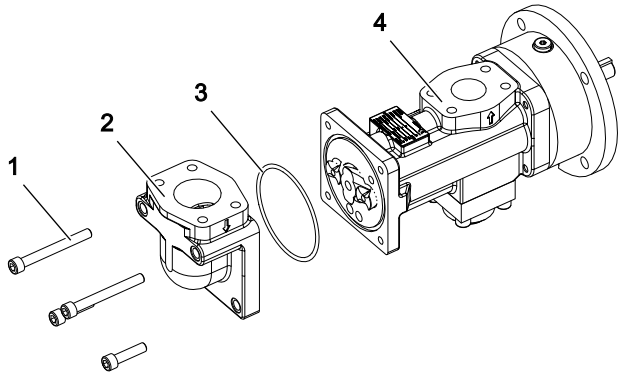
9 Connection

9.1 Dangers during connection work

The following safety instructions must be observed strictly:
☐ Have all work on the pump and pipe system only carried out by authorized qualified personnel.
☐ Ensure that impurities cannot get into the pump and pipe system.
☐ Ensure that mechanical connections are mounted stress-free.
☐ Observe the tightening torques ↳ Appendix, Page 47.
☐ Have all the work on the electrical equipment only carried out by electricians.
☐ Before beginning work on the pump 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 Turning the radial suction cover

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



1. Remove the screws **1** and remove the radial suction cover **2**.
2. Ensure that the O-ring **3** is inserted in the pump housing.
3. Turn radial suction cover **2** and tighten with screws **1**.

9.3 Connecting the pump to the pipe system

Personnel qualification:	☐ Transport personnel ☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Protective helmet ☐ 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/pump unit.

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.

► 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 is mounted free of mechanical stresses in the pipe system.

► Observe the tightening torques.

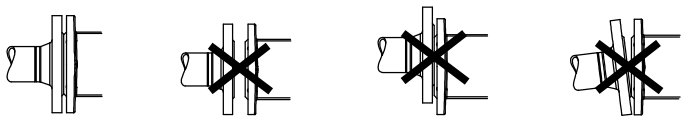


Fig. 10: Connection to pipe system

1. Turn the pump shaft or the fan impeller of the motor. This tests that the pump runs smoothly. If the pump shaft cannot be turned by hand, remedy the fault before installing the pump Troubleshooting, Page 43.
2. Before carrying out welding work mount a protective cover on the suction connection and pressure connection.
3. Place the piping in position and support the weight of the piping.
4. 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.
5. Tighten the connecting screws crosswise with torque, Table of tightening torques Appendix, Page 47.

9.4 Insulating the pump

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

⚠ 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

Hot surface.

Touching of uninsulated hot surfaces results in burns.

► Insulate components and pipings in which hot liquids (> 60 °C) flow before commissioning.

Before commissioning, carefully insulate all potentially hot surfaces of the pump and the connected piping or provide suitable protection against accidental contact.

9.5 Connecting the pump unit to the power supply

Personnel qualification:	☐ Electrician
Aids:	☐ Operating instructions of the motor ☐ Motor circuit diagram

⚠ 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.

⚠ 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. Ensure that the operating data on the rating plate of the motor agree with the operating data of the pump and with the local power supply.
2. Carefully earth the pump bracket foot, base frame or pedestal via the screwing.
3. Connect the motor in accordance with the operating instructions and circuit diagram in the motor terminal block.
4. When connecting the pump unit 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 pipe system on the pressure side before the first shut-off device.
- ☐ Before commissioning, make sure that the suction line and pump are filled.
- ☐ Pumped liquids can be hot, poisonous, combustible and caustic. Use corresponding protective equipment.
- ☐ Ensure that the pump station is only operated within the operating limits.
- ☐ Wear hearing protection if you work for a longer time directly at the pump.
- ☐ Ensure that the maximum permissible system pressure is not exceeded.
- ☐ Ensure that during cooling down or heating up the pump 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 impair the service life of the pump. If the pipe system is flushed using the pump during the initial commissioning, an additional commissioning filter has to be installed temporarily before the pump at the system.

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.

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 installed (mesh width 0.02 mm)

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

10.2.2 Filling and venting the pump

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

⚠ DANGER

Magnetic field.

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

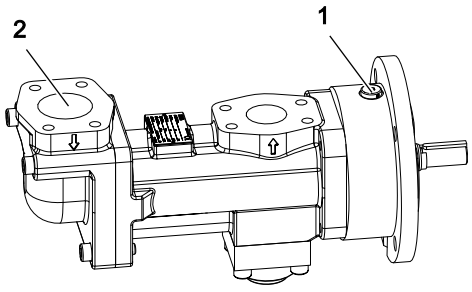
- ► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.

⚠ DANGER

Risk of death through discharging pumped liquid.

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

- ► Wear personal protective equipment 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.



1 Vent hole sealing chamber
2 Suction connection

1. ▶ Open the screw plug of the vent hole **1** by a max. of 2 rotations so that air can escape during the filling process.
2. ▶ Open the suction-side shut-off valve and fill the pump via the suction connection **2** until the pumped liquid emerges at the vent hole **1**.
3. ▶ During the filling process turn the pump shaft or the motor fan impeller manually in the direction of rotation of the pump in order to speed up the filling process.
4. ▶ Retighten the screw plug of the vent hole **1**.

10.2.3 Checking the direction of rotation

The direction of rotation is indicated by an arrow on the pump flange/pump housing. 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 flange 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/pump unit.

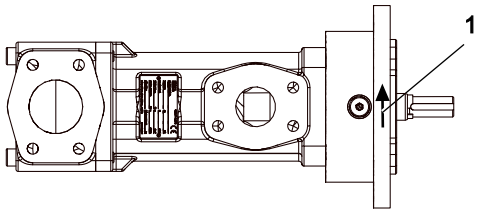
ATTENTION

Dry running can damage pump equipment.

► Ensure that the pump is filled properly.

► Switch the pump on for a maximum of one second and then off again immediately.

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 for the direction of rotation **1**.
3. ▶ If the directions do not match, swap the two electrical connection phases. Repeat Steps 1 and 2.

10.2.4 Commissioning the pump

Personnel qualification:	☐ Fitter ☐ Electrician
Personal protective equipment:	☐ Work clothing ☐ Face protection ☐ Protective gloves ☐ Safety boots
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/pump unit.

⚠ DANGER

Risk of death resulting from bursting components and discharging pumped liquid.

As a result of impermissibly high pressure, components can burst with high energy, for example through the pressure-side pipe system being shut off.

- ► Wear personal protective equipment during all the work.
- ► System protection: Before carrying out commissioning ensure that a safety valve is installed in the pressure-side pipe system at the system end.
- ► Pump protection: Ensure before commissioning that an integrated overflow valve or system-side overflow valve/safety valve is installed.

⚠ 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

Hot surface.

Touching of uninsulated hot surfaces results in burns.

- ► Insulate components and pipings in which hot liquids (> 60 °C) flow before commissioning.

⚠ 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:

- ✓ Pump unit set up correctly
- ✓ Connections connected sealingly
- ✓ Motor connected correctly
- ✓ Pipe system is free of impurities
- ✓ System protection: Safety valve in accordance with EN ISO 4126-1 installed in the pressure-side pipe system before the first shut-off device
- ✓ Pump protection: Integrated overflow valve or system-side overflow valve/safety valve installed.
- ✓ Filter/strainer with magnetic separator installed on suction side
- ✓ Pump filled with pumped liquid
- ✓ Shut-off devices in the suction line and pressure line opened

1. If present, turn the motor fan wheel. This tests that the pump runs smoothly.
   If the pump shaft cannot be turned by hand, rectify the fault. Troubleshooting, Page 43
2. Switch on the pump unit.
   ⇨ The pump delivers when the pressure on the pressure side of the pump rises or a flow indicator at the system side triggers.

3. If the pump does not deliver after 10 – 15 seconds of operation, abort commissioning. Eliminate the cause for the fault and only then continue with commissioning. Take the information from the fault table into account Troubleshooting, Page 43.
4. Run the pump 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.
5. Checking overflow valve functions During operation, Page 25.

10.3 During operation

10.3.1 Checking the operating pressure

Personnel qualification:	☐ Trained personnel

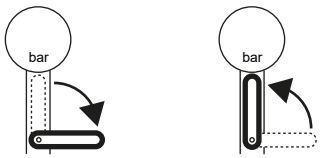


Fig. 11: Pressure gauge shut-off valves closed/open - principle diagram

⚠ 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.

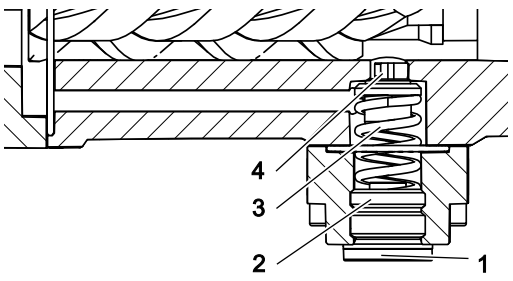
1. Open the pressure gauge shut-off valve.
2. Read the operating pressure and close the pressure gauge shut-off valve.

10.3.2 Adjusting the overflow valve

Personnel qualification:	☐ Fitter
Aids:	☐ Allen key

Note
- ☐ The protection of the pump must be ensured either through an integrated overflow valve or through an overflow valve/safety valve installed on the system side. The overflow valve/safety valve must be installed pressure-side between the pump and the first shut-off valve.
- ☐ Observe the associated operating instructions and dimensioning sheet of the pump to set an overflow valve/safety valve installed on the system side.

Note The opening pressure of the overflow valve is set at the factory to at least 1 bar or 110 % of the differential pressure.



1 Screw plug
2 Adjusting screw
3 Pressure spring
4 Valve body

Fig. 12: Overflow valve

⚠ WARNING

Risk of injury through emitted pumped liquid.

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

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

Requirement:

✓ Pressure-side pressure gauge installed

1. ▶ Switch on the pump unit 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 28

✓ 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 Switching off the pump unit

Personnel qualification:	☐ Trained personnel

ATTENTION

Seal damage through pressurizing during standstill.

► Ensure that the maximum permissible system pressure is not exceeded.

1. ▶ Switch off the motor.
2. ▶ Close the pressure-side shut-off device.

10.4 Decommissioning

10.4.1 Decommissioning the pump

Decommissioning is an operation interruption that requires different measures depending on the scope and duration of the interruption as well as the properties of the pumped liquid.

Personnel qualification:	☐ Fitter ☐ Electrician
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
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/pump unit.

⚠ WARNING

Risk of injury through emitted pumped liquid.

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

► Wear personal protective clothing during all the work. Ensure face protection.

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

ATTENTION

Damage to equipment through excessively fast temperature change.

► Subject the pump only to slow temperature changes.

► Under no circumstances heat the pump with an open flame.

▶ Carry out the following measures during operation interruptions:

Scope of the operation interruption	Measure
☐ Shutting down the pump for a longer period	→ Depending on the pumped liquid
☐ Draining the pump	→ Close the pressure-side and suction-side shut-off devices.
☐ Dismantling the pump	→ Disconnect the motors from the power supply and secure against being switched back on.
☐ Storing the pump	→ Observe measures for storing and preservation ↳ Transportation, storage, Page 12.

Tab. 7: Measures during operation interruptions

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

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

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

10.5 Recommissioning

10.5.1 Recommissioning the pump

→ Depending on the extent and duration of the interruption of operation, carry out steps as for commissioning ↳ Commissioning, Page 21.

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 unit 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 liquid 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 and the requirements from the operating instructions of the components.

Component	Required maintenance	Cycle
Filter/strainer (system side)	☐ Check of the suction-side pressure	2 weeks
Pump	☐ Visual inspection ☐ Acoustic inspection	4 weeks
Leakage vent hole	☐ 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	☐ Functional test ↳ Operation, Page 21	≤ 5 years

Tab. 9: 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

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

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.

1. ▶ Check the pump visually and acoustically every four weeks.
2. ▶ If there are signs of wear, eliminate the cause ↳ Servicing, Page 33.

11.5 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.

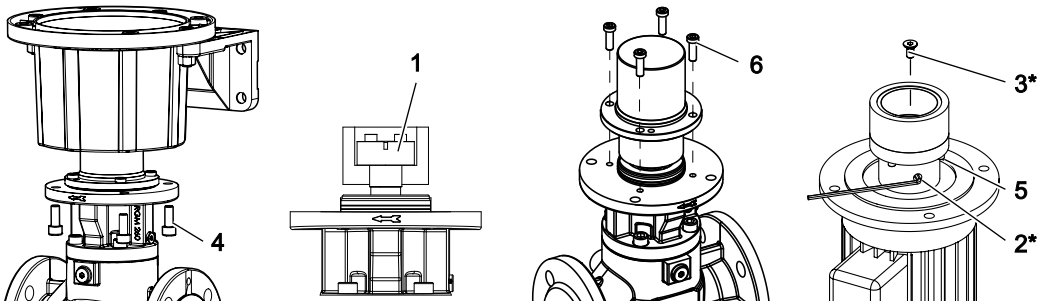
Components of the magnetic coupling heat up more than the pump during operation. Touching the magnetic coupling will result in burns.

► 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 33, tightening torques to be observed ↳ Appendix, Page 47.
2. Carefully clean outer surfaces of the inner rotor, outer rotor and containment can from metallic solids and other adherences ↳ Servicing, Page 33.
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 33.

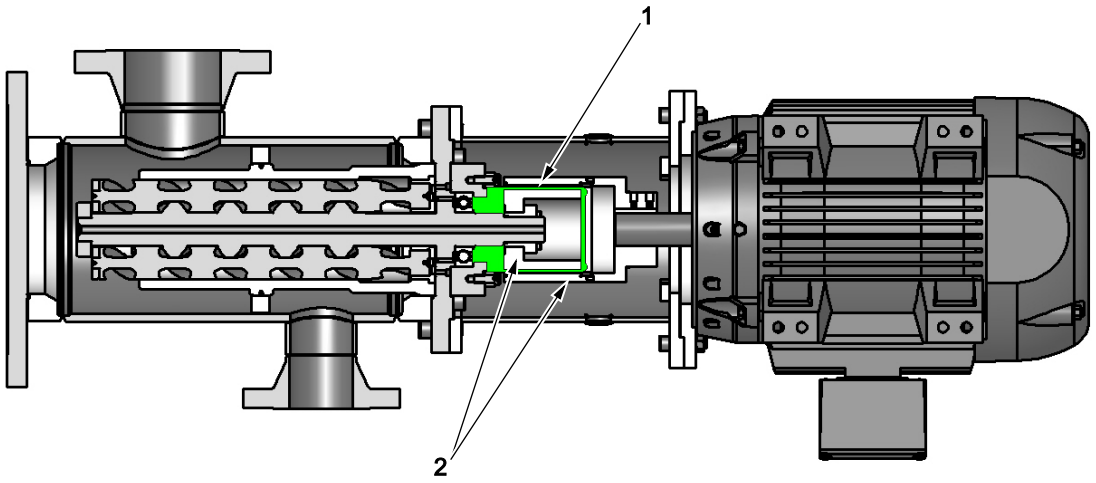
Check tightening torques



Item No.	Part
1	Tensioning element
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. 10: 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.

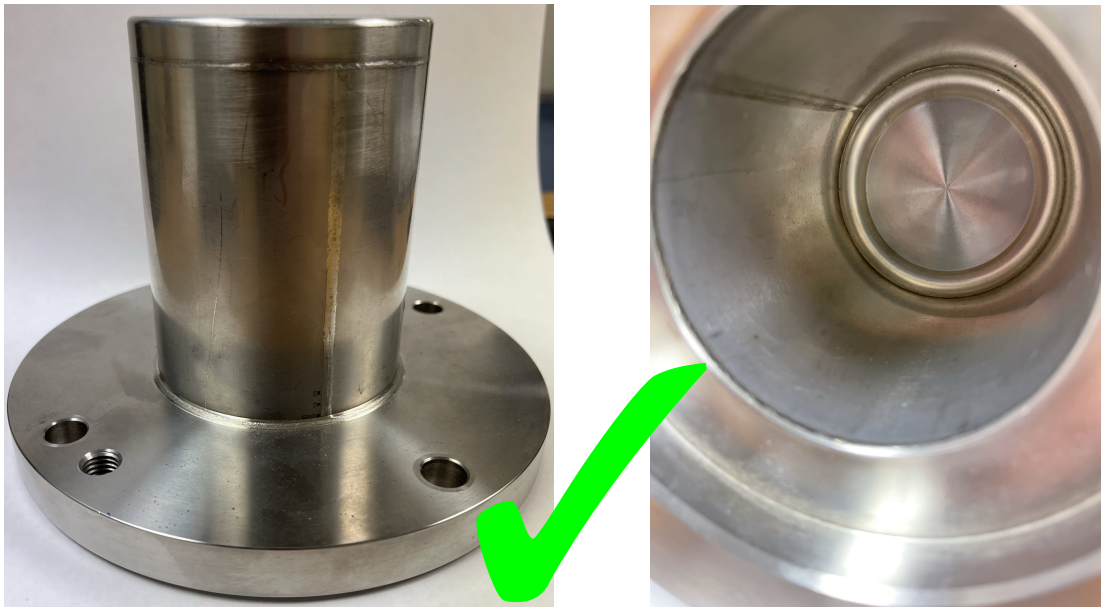


Fig. 13: Containment can
Left: Outer surface free from grooves
Right: Inside free from grooves

Fig. 14: 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.

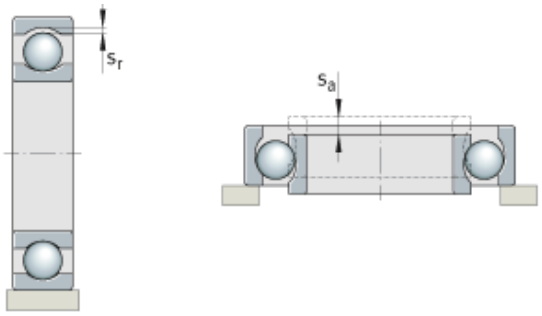
Fig. 15: Inner rotor
Left: Inner rotor without adhesions
Right: Large amount of iron particles accumulated on the inner rotor

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. 16: 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. 17: 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 ensure that the electrical power supply is deenergized and is secured against being switched back on.
- ☐ Before beginning work, let the pump unit 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 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 liquid is sufficiently large.
- ☐ Observe the tightening torques ↳ Appendix, Page 47.
- ☐ 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 pump elements:

Finding	Cause	Elimination
Increased running noises	Incipient damage to bearing	→ Replace the ball bearing.
Reduction in the delivery rate or pressure under constant operating conditions	Advanced wear of screws and housing	→ Replace the pump.

Tab. 11: Signs of wear

12.3 Replacing the magnetic coupling

12.3.1 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.
- ► In the case of vertical transportation secure the motor against tippling.
- ► 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. ► Before dismantling close the suction connection and pressure connection of the pump with protective covers.
2. ► Fixate the pump unit with suitable measures so that the pump cannot tilt after dismantling of the motor.

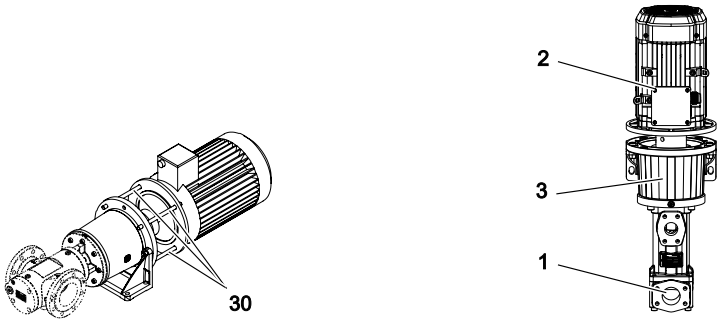
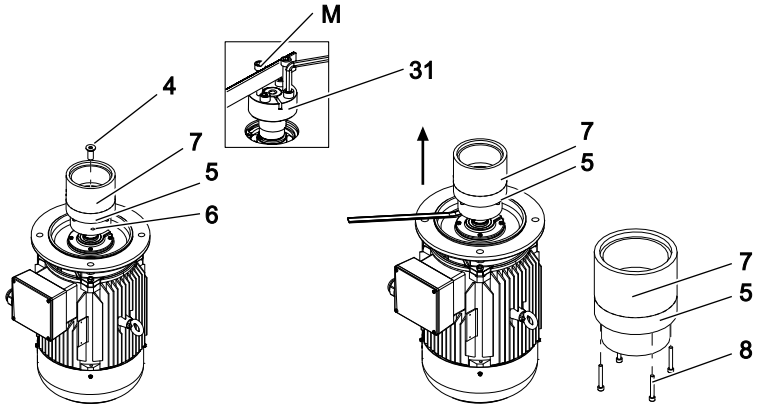


Fig. 18: Use of positive guide - priniciple diagram

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



6. ► 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.
7. ► Pull the outer coupling hub and the outer rotor off from motor shaft using mounting levers.
8. ► Remove the socket screws **8** between the outer coupling hub and the outer rotor.

Only if outer coupling hub with clamping element is fitted:

9. ► Remove the cap screws **8** and outer rotor **7**.
10. ► 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.

11. Loosen the locking screws of the clamping element with an Allen key.
12. Pull the outer coupling hub **5** off the motor shaft using mounting levers.
13. Remove cap screws **8** from the outer coupling hub.

12.3.2 Removing the inner rotor

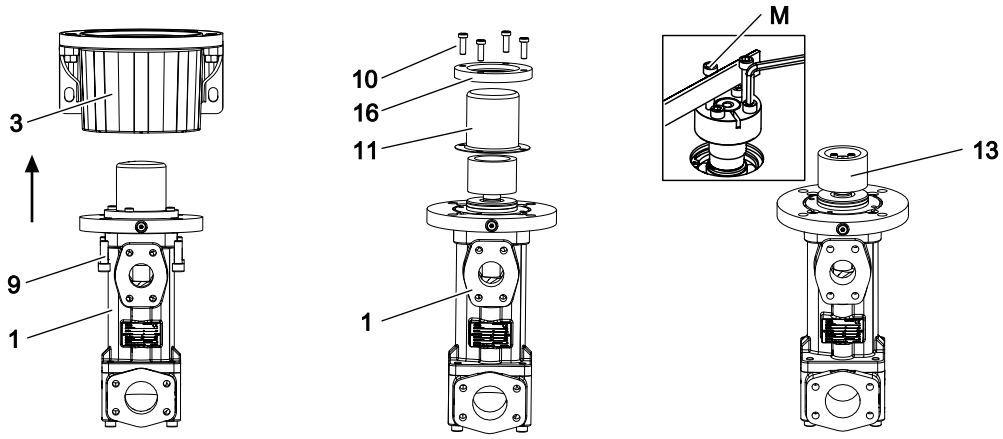
Personnel qualification:	☐ Fitter ☐ Work clothing ☐ Protective gloves ☐ Safety boots ☐ Allen key ☐ Anti-rotation screw

⚠ 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. Remove the socket screws **9** between the pump **1** and pump bracket **3** and remove the pump bracket.
2. Remove the socket screws **10** between the containment can **11** and the pump and remove the containment can. For multi-part containment cans, remove the center flange **16**.
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. Insert a suitable anti-twist device (e.g. pry bar) between the two screws **M** to fix the clamping element **12**.
5. Loosen the locking screws of the clamping element **12** with an Allen key and remove the inner rotor **13** from the shaft.
6. or fix the
inner rotor **13** with a strap spanner, loosen the fixing screws of the clamping element **12** with the Allen key and remove the inner rotor **13** from the shaft.

12.3.3 Installing the inner rotor

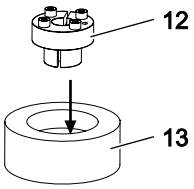
Personnel qualification:	☐ Fitter ☐ Work clothing ☐ Protective gloves ☐ Safety boots ☐ Oil without molybdenum sulphide additive (e.g. multifunction spray WD-40)

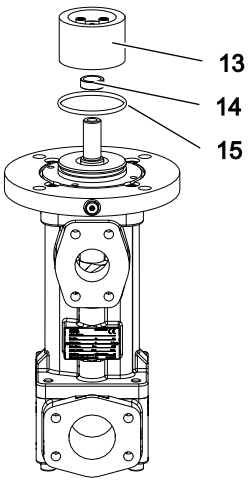
⚠ DANGER

Magnetic field.

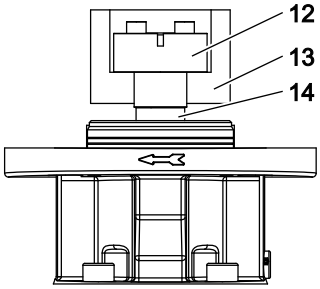
Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

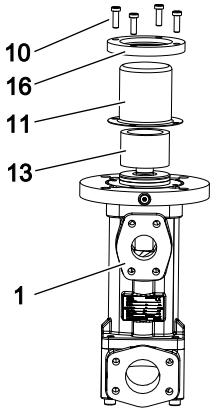
► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.

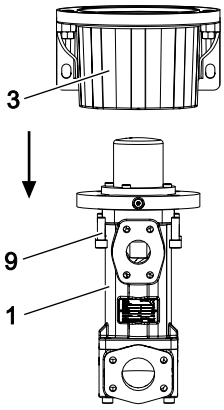




1. Carefully clean the contact surfaces of the inner rotor **13**, oil the tensioning element **12** lightly.
2. Manually turn out the screws of the tensioning element by a few turns and insert the tensioning element in the inner rotor.
3. Carefully clean the sealing surfaces.
4. Clean and lightly grease the O-ring **15**. Insert the O-ring and slide the distance sleeve **14** onto the pump shaft.







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 clamping element has to lie flat on the distance sleeve 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 torque.
8. Press the containment shell **11** and, in the case of a multi-piece containment shell, the centre flange **16** onto the pump flange and tighten the socket screws **10** to torque.
9. Place the pump bracket **3** on the pump and tighten the socket screws **9** with torque.

12.3.4 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.

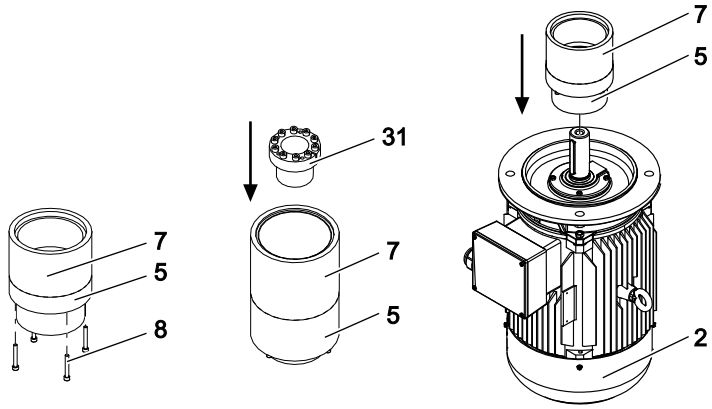
► Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.

⚠ WARNING

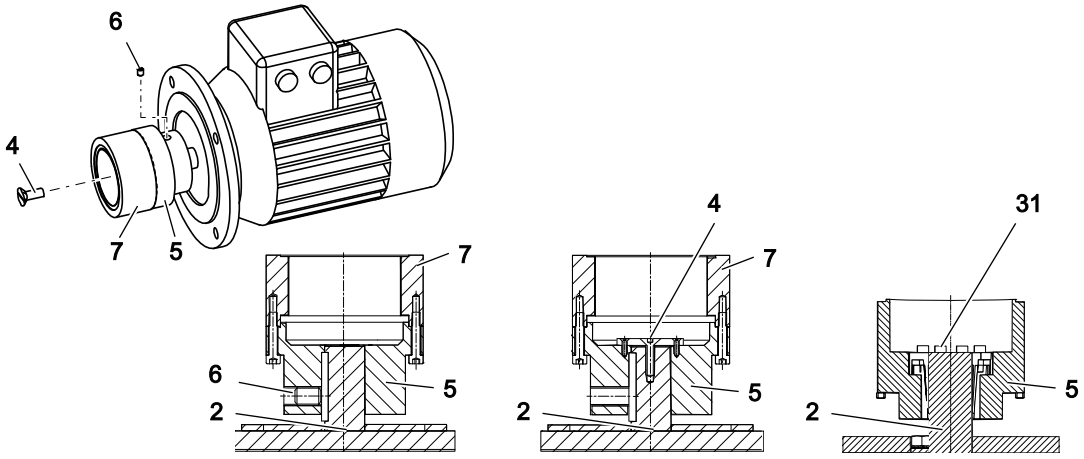
Danger of crushing between motor and pump.

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 47.
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.

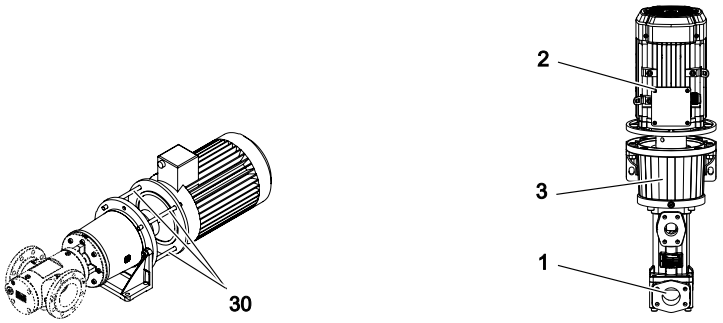


Fig. 19: Use of positive guide - priniciple diagram

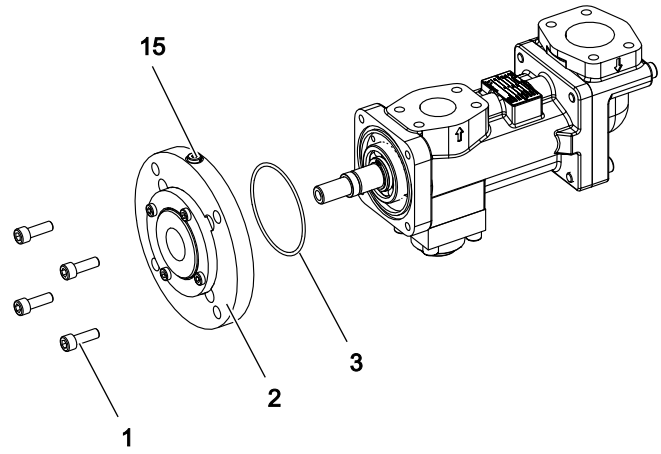
6. ▶ Fixate the pump **1** with suitable measures, so that the pump cannot tilt during mounting of the motor.
7. ▶ Attach the hoisting equipment to the motor **2** and position it above the pump.
8. ▶ Insert the positive guide **30** between the motor and the pump bracket **3**.
9. ▶ Place the motor slowly on the pump bracket of the pump via the positive guide. Ensure that the outer rotor **7** does not strike the containment can.
10. ▶ Remove the positive guide.
11. ▶ Screw in the cap screws between the pump bracket and the motor and tighten them with torque.
12. ▶ Make sure that the outer rotor does not rub against the containment can by turning the fan wheel of the motor.
13. ▶ Do not remove the protective cover until just before reconnecting the pump to the pipe system.

12.4 Replacing the ball bearing

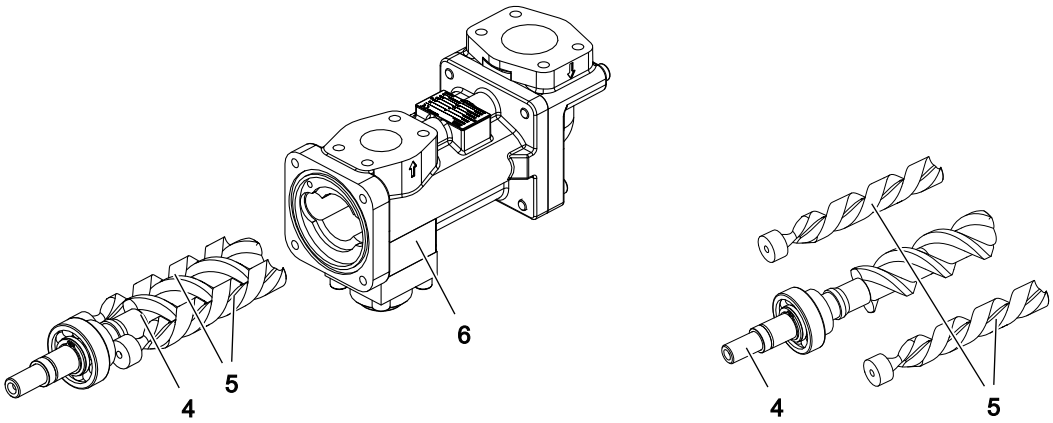
12.4.1 Removing the ball bearing

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

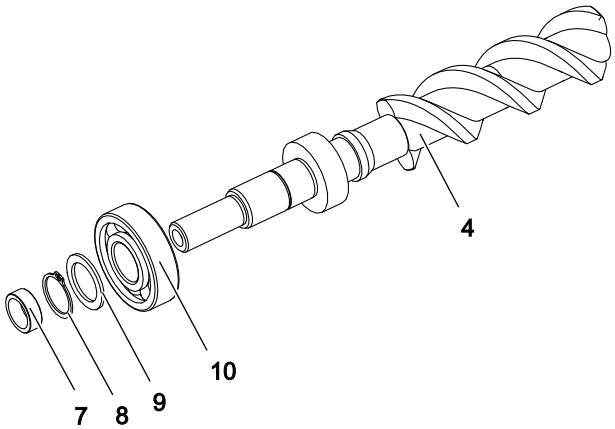
Requirement:
✓ Pump unit disconnected from the electrical power supply, deenergized and secured against being switched back on
✓ Magnetic coupling removed



1. Mark the position of the vent hole **15** on the pump housing **6**.
2. Remove the socket screws **1** and take off the flange cover **2**.
3. Remove the O-ring **3**.



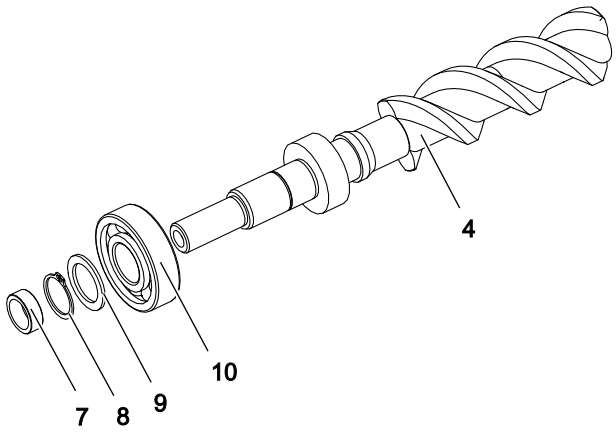
4. Remove the spindle set (main spindle **4** with secondary spindles **5**) with ball bearing from pump housing **6**.
5. Remove the idle screws **5** from the main screw **4**.



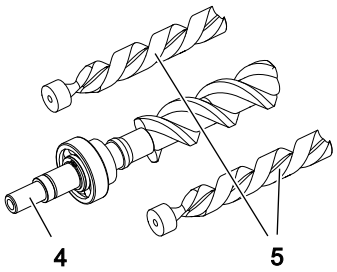
6. Remove the spacer ring **7**, circlip **8** and support disc **9** from the main spindle **4**.
7. Use an extractor to pull the ball bearing **10** off the main screw.

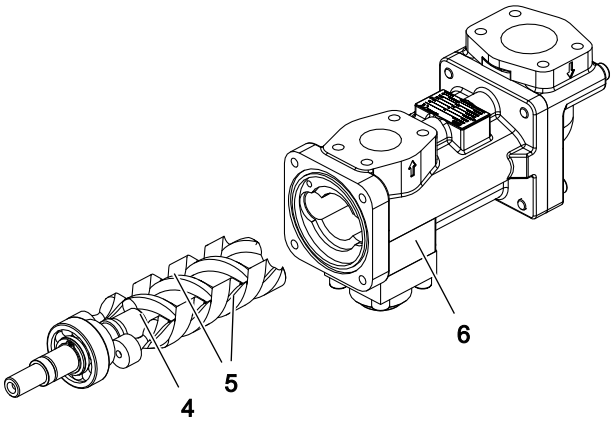
12.4.2 Installing the ball bearing

Personnel qualification:	☐ Fitter
Personal protective equipment:	☐ Work clothing ☐ Protective gloves ☐ Safety boots
Aids:	☐ Mounting sleeve ball bearing ☐ Torque wrench

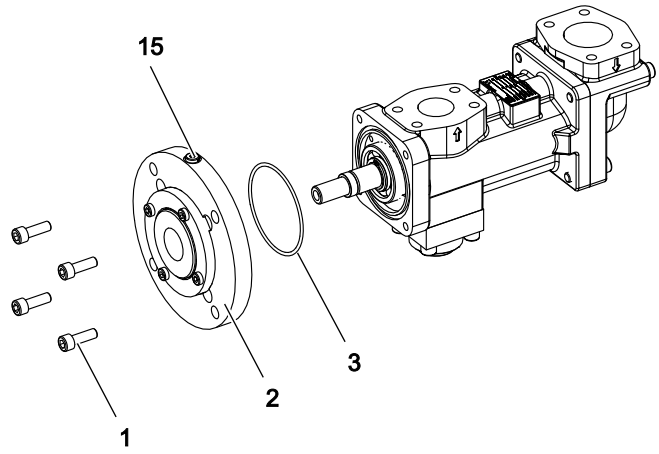


1. Press the ball bearing **10** with ball bearing mounting sleeve **C** onto the main screw.
2. Fit the support disc **9** and circlip **8** on the main spindle **4**. Slide the spacer ring **7** onto the main spindle **4**.





3. Place the idle screws **5** to the left and right of the main screw **4**.
4. Slide the pre-assembled secondary spindles **5** and main spindle **4** into the pump housing **6** in a vertical position.



5. Lightly grease the O-ring **3** and position it on the pump housing **6**.
6. **Warning:** When installing the flange cover **3**, ensure that the vent hole **15** is positioned in the same place as before removal (see mark on the pump housing **6**).
   Carefully slide the flange cover **2** onto the main spindle **4** as far as it will go.
7. Tighten the socket screws **1**.

13 Disposal

13.1 Dismantling and disposing of the pump

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/pump unit.

⚠ 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 unit from the power supply and secure it against being switched back on
✓ Pump unit cooled down to the ambient temperature and disconnected from the pipe system
✓ Pump emptied completely
✓ Pump placed at a location suitable for dismantling

1. Dismantle the pump 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 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	–	–	–	–	–	–	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 18.
–	–	–	4	–	–	–	Differential pressure too high	
								▶ Reduce the differential pressure.
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.

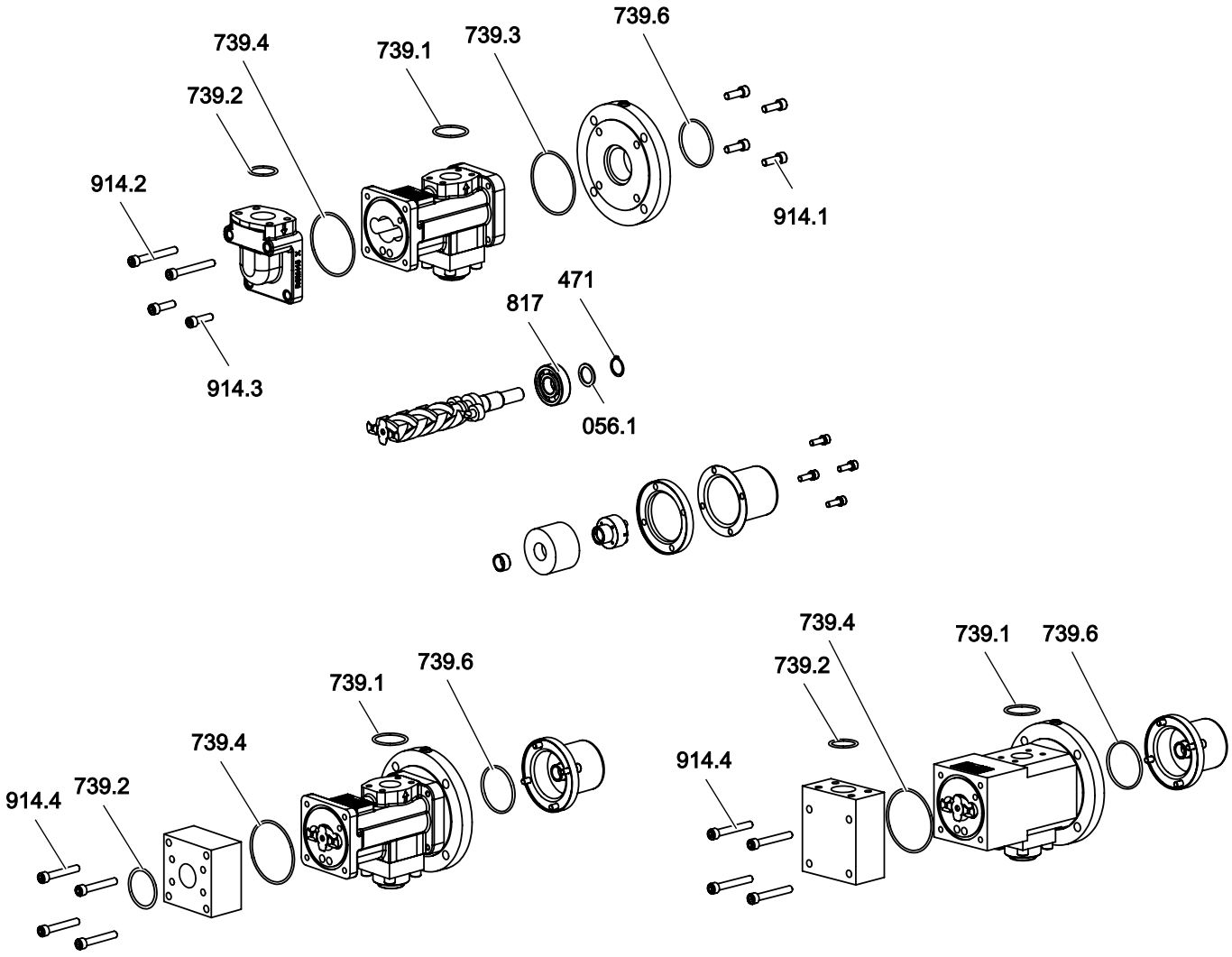
Fault identification							Cause	Remedy
–	2	3	–	5	–	–	Airlock/gas in the pumped liquid	
								1. Test the pipe system for air admission, replace leaking parts. 2. Reduce the suction head. -or- Increase the inlet pressure.
–	2	–	4	–	–	–	Speed/frequency/voltage of the motor false	
								1. Ensure that 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	3	–	5	–	–	Overflow valve opens during normal operation	
								Set the opening pressure to 110% of the differential pressure During operation, Page 25.
–	2	–	–	5	–	–	Overflow valve leaks	
								Contact the manufacturer.
–	2	–	–	–	–	–	Advanced wear of the housing/screw set	
								Contact the manufacturer.
–	–	3	–	–	–	–	Pump subject to mechanical stress	
								Connect the pump correctly to the pipe system Connection, Page 18.
–	–	3	–	–	–	–	Vibrations/pulsations in the system	
								Bear the pump unit elastically. -or- Make the connections with hoses.
–	–	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	
								Contact the manufacturer.
–	2	3	4	–	–	7	Superficial damage to pump parts coming into contact with the liquid	
								Contact the manufacturer.
–	–	–	4	–	–	7	Foreign bodies in the pump	
								Contact the manufacturer.
–	–	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.
–	2	3	–	–	–	–	Magnetic coupling interrupted	
								1. Stop the pump immediately and restart it. 2. Avoid excessive differential pressures. 3. At repeated occurrence check whether pump has got stuck.
1	–	–	–	–	–	7	Containment can defective	
								Replace the containment can Servicing, Page 33.

Tab. 12: Fault table

15 Spare parts

15.1 Maintenance kit for magnetic coupling GF, GH

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

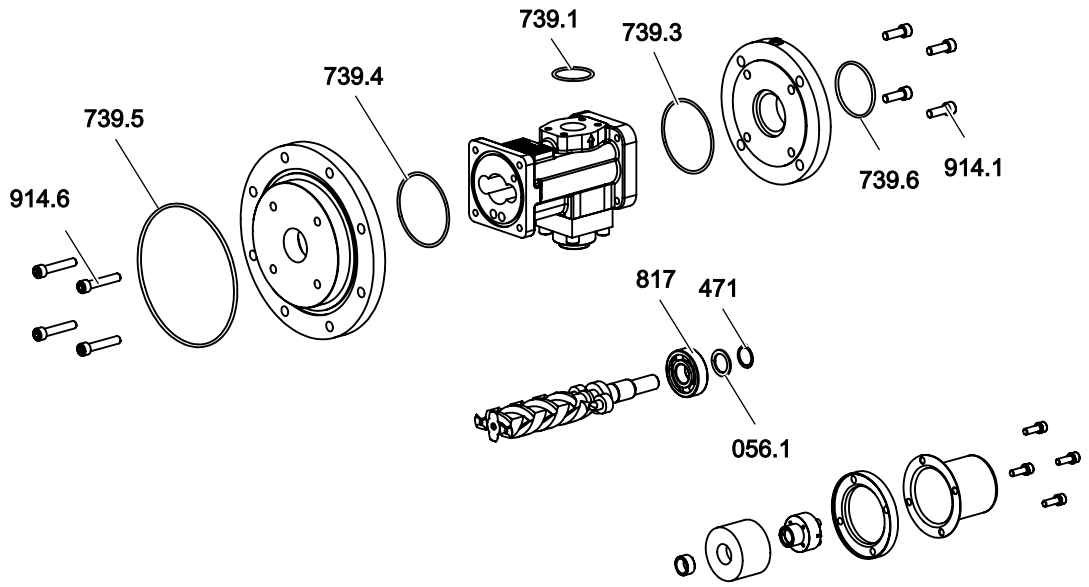


Qty.	Item No.	Part		Qty.	Item No.	Part
1	**056.1**	Supporting ring		1	**817**	Ball bearing
1	**471**	Circlip		4	**914.1**	Socket screw
1	**739.1**	O-ring		2	**914.2**	Socket screw
1	**739.2**	O-ring		2	**914.3**	Socket screw
1	**739.3**	O-ring		4	**914.4**	Socket screw
1	**739.4**	O-ring		1		Mounting sleeve ball bearing
1	**739.6**	O-ring				

Tab. 13: Maintenance kit GF, GH

15.2 Maintenance kit for magnetic coupling

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



Qty.	Item No.	Part		Qty.	Item No.	Part
1	**056.1**	Supporting ring		1	**817**	Ball bearing
1	**471**	Circlip		4	**914.1**	Socket screw
1	**739.1**	O-ring		4	**914.6**	Socket screw
1	**739.3**	O-ring		1		Mounting sleeve ball bearing
1	**739.4**	O-ring				
1	**739.5**	O-ring				
1	**739.6**	O-ring				

Tab. 14: Maintenance kit GT

16 Appendix

16.1 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. 15: 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.

16.2 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. 16: Tightening torques with thread measured in inches

16.3 Tightening torques for screws of tensioning elements

Tightening torque [Nm]	
Thread	**12.9**
M 3	2.1
M 4	5.1
M 6	17.4
M 8	42.2
M 10	83.0
M 12	144

Tab. 17: Tightening torques tensioning elements

16.4 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. 18: Directives observed

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