

KRAL screw pumps.

R Series

Mechanical seal

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Original instructions

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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

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







2 Safety

2.1 Proper use

1.4.2 Danger signs

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

1.4.3 Symbols in this document

	Meaning
	Warning personal injury
	Safety instruction
	Request for action
	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.

3 Identification

3.1 Type code

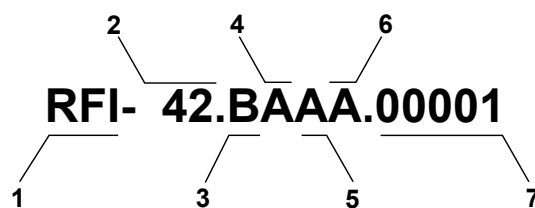


Fig. 1: Type code

Item	Classification	Description	
1	Type	RFI	<input type="checkbox"/> Pump with free shaft end <input type="checkbox"/> Pump with inline flanges PN16 <input type="checkbox"/> Pump unit with pump bracket foot
		RVI	<input type="checkbox"/> Pump with free shaft end and pedestal for vertical mounting <input type="checkbox"/> Pump with inline flanges PN16 for vertical mounting <input type="checkbox"/> Pump unit on pedestal for vertical mounting
		RFT	<input type="checkbox"/> Pump with free shaft end <input type="checkbox"/> Pump with overhead flanges PN16 according to marine industry standards <input type="checkbox"/> Pump unit with pump bracket foot
		RVT	<input type="checkbox"/> Pump with free shaft end and pedestal for vertical mounting

4 Technical data

3.2 Rating plate

Item	Classification	Description
		<input type="checkbox"/> Pump with overhead flanges PN16 according to marine industry standards for vertical mounting <input type="checkbox"/> Pump unit on pedestal for vertical mounting
2	Size	Corresponds to delivery rate in [l/min] at 1450 min ⁻¹
3	Shaft seal	B Mechanical seal of hard material
		D Magnetic coupling
4	Pressure stage overflow valve	A Pressure stage 6 bar ± 10 %
		B Pressure stage 10 bar ± 10 %
5	Variant	A Not assigned
6	Completion	A Pump with free shaft end
		B Pump with pump bracket
		C Pump with pump bracket and motor
7	Version index	For internal administration

Tab. 2: Type code

3.2 Rating plate

6	KRAL	CE	1	Construction year
5	Art.-Nr. Item no.		2	Max. allowable working pressure suction-side/Max. allowable working pressure pressure-side
4	Typ Type	Δp bar	8	
3	SN Serial no.	Q l/min	9	
2	Tmin. / Tmax.	°C n min ⁻¹	10	
1	ps max. / pD max.	bar v mm ² /s	11	
	Jahr Year	Gewicht Weight kg		
	KRAL GmbH, 6890 Lustenau, Austria			
	www.kral.at			

Fig. 2: Rating plate

4 Technical data

4.1 Operating limits

Parameter	Unit	Size				
		15–20	32–42	55–85	105–118	160–210
Max. allowable working pressure						
<input type="checkbox"/> Pump housing	[bar]	16				
Max. temperature of the pumped liquid						
<input type="checkbox"/> Mechanical seal of hard material	[°C]	180				
Ambient temperature min. - max.	[°C]	-10 ... 50				
Min. – max. viscosity	[mm ² /s]	1.4–10 000				
Speed max.						
<input type="checkbox"/> At 50 Hz	[min ⁻¹]	2900		1450		
<input type="checkbox"/> At 60 Hz	[min ⁻¹]	3500		1750		

Parameter	Unit	Size				
		15–20	32–42	55–85	105–118	160–210
Inlet pressure						
<input type="checkbox"/> Mechanical seal of hard material	[bar]	6				

Tab. 3: Operating limits

4.2 Short-circuit pressure of the overflow valve

Size	Short-circuit pressure [bar] at speed [min^{-1}]							
	Overflow valve A				Overflow valve B			
	1450	1750	2900	3500	1450	1750	2900	3500
15–20	6.5	7.0	7.5	8.0	10.5	11.0	12.0	12.5
32–42	6.5	7.0	7.5	8.5	10.5	11.5	12.5	14.0
55–85	7.5	8.0	9.0	10.0	13.0	13.5	14.0	15.0
105–118	7.5	8.0	9.0	10.0	12.0	12.5	13.0	14.0
160–210	8.0	8.5	10.0	11.0	13.0	13.5	15.0	16.0

Tab. 4: Short-circuit pressure of the overflow valve

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
	Max. sound pressure level ± 3 [dB(A)]				
Pump	52.0	55.0	60.0	60.0	65.0
Motor	55.0	55.0	62.0	62.0	64.0
Pump unit	57.0	58.0	64.0	64.0	68.0

Tab. 5: Sound pressure level

4.5 Weights

The weight is specified on the rating plate.

5 Function description

5.1 Pump structure

5 Function description

5.1 Pump structure

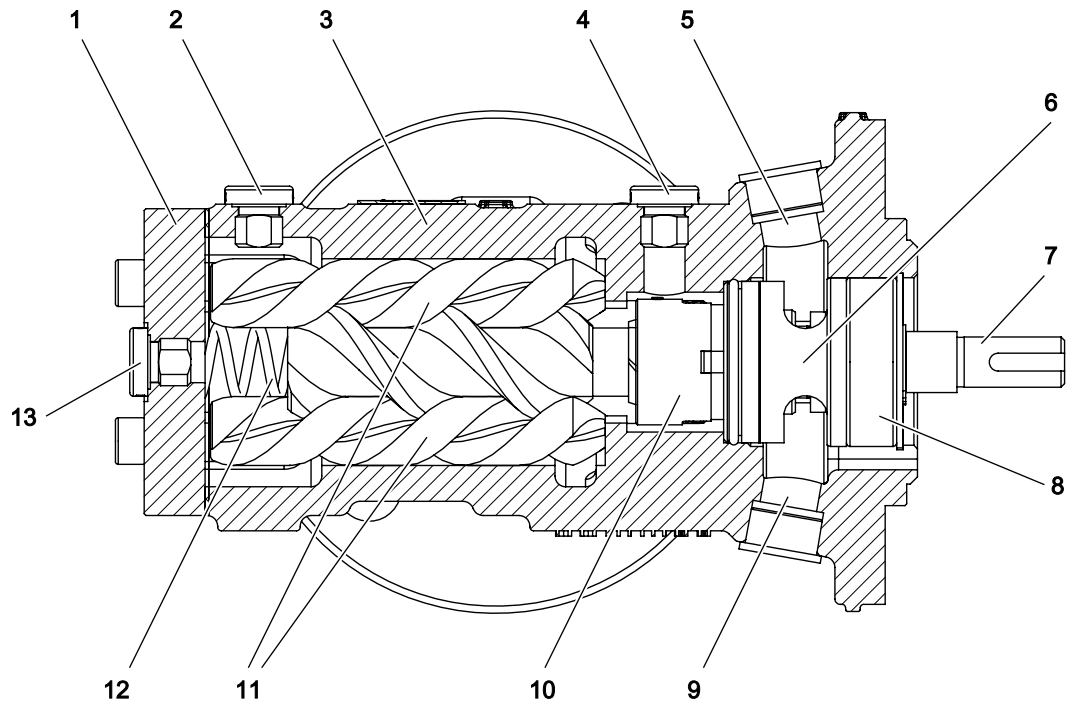


Fig. 3: Pump structure

1	End cover	8	Ball bearing
2	Screw plug	9	Leakage vent hole
3	Pump housing	10	Mechanical seal
4	Screw plug	11	Idle screw
5	Leakage vent hole	12	Overflow valve
6	Sealing sleeve	13	Screw plug
7	Main screw		

5.2 Pump unit structure

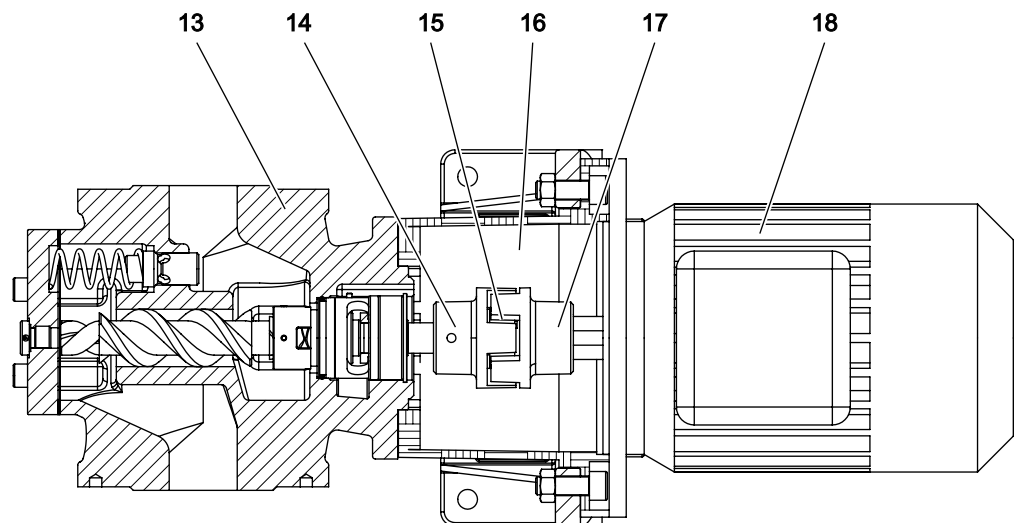


Fig. 4: Pump unit structure

13	Pump	16	Pump bracket
14	Pump-side coupling half	17	Motor-side coupling half

15 Coupling intermediate ring

18 Motor

5.3 Functional principle

Screw pumps are rotating displacement pumps. Their displacement effect results from three rotating screws **7** 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 tolerances, suspended solids cannot be pumped.

The axial support of the main screw is provided by a lifetime-lubricated ball bearing **8**.

An integrated overflow valve **11** 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 **18** and is marked on the pump flange by an arrow.

The flow direction is marked on the pump housing by two arrows.

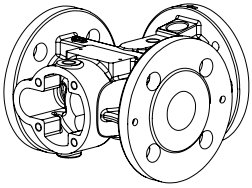
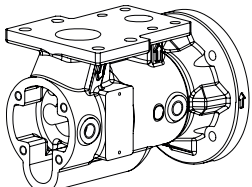
5.4 Mechanical seal

The functional principle of the mechanical seal is based on forming a hydrodynamic film between the rotary seal ring and stationary seal ring of the mechanical seal. Forming this seal prevents dry friction between both components, meaning that stability of the film is of elemental importance for the functionality of the mechanical seal. Forming a liquid film however means that due to the differential pressure on the seal, liquid is always pushed through the gap filled with liquid. A correctly constructed mechanical seal therefore always has a low level of leakage.

This leakage level depends on various factors, mainly including size, rotation speed and differential pressure. A leakage of less than 10 drops/hour ($\approx 0.5 \text{ cm}^3/\text{h}$) is normal and is no reason for replacing the mechanical seal.

The integrated leakage vent hole **5** or **9** allows draining of this leakage. The drainage through this hole has to be kept free ↴ Maintenance, Page 24. Dry running must be avoided at all costs, as the seal will overheat and be destroyed in a matter of minutes.

5.5 Housing variants

Housing	Type	Description
	RFI/RVI	Flange arrangement: Inline flange PN16
	RFT/RVT	Flange arrangement: Overhead flange PN16 according to marine industry standards

Tab. 6: Housing variants

5.6 Overflow valve

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. Circulation through the overflow valve for too long furthermore heats the pump to excess. This reduces viscosity and can ultimately lead to pump failure.

6 Transportation, storage

6.1 Dangers during transportation

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

Two variants of the overflow valve are available. The valve spring is pretensioned to the respective opening pressure:

Parameter	Unit	Overflow valve A	Overflow valve B
Pretension Δp	[bar]	$6 \pm 10 \%$	$10 \pm 10 \%$

Tab. 7: Pretension valve spring

Short-circuit pressure of the overflow valve ↪ Technical data, Page 6.

- Note**
- A function test of the overflow valve at least every 5 years is essential for the safe operation ↪ During operation, Page 22.
 - 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

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



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 tipping.
- ▶ Do not stand under raised loads.

ATTENTION

Damage to equipment through improper transportation.

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

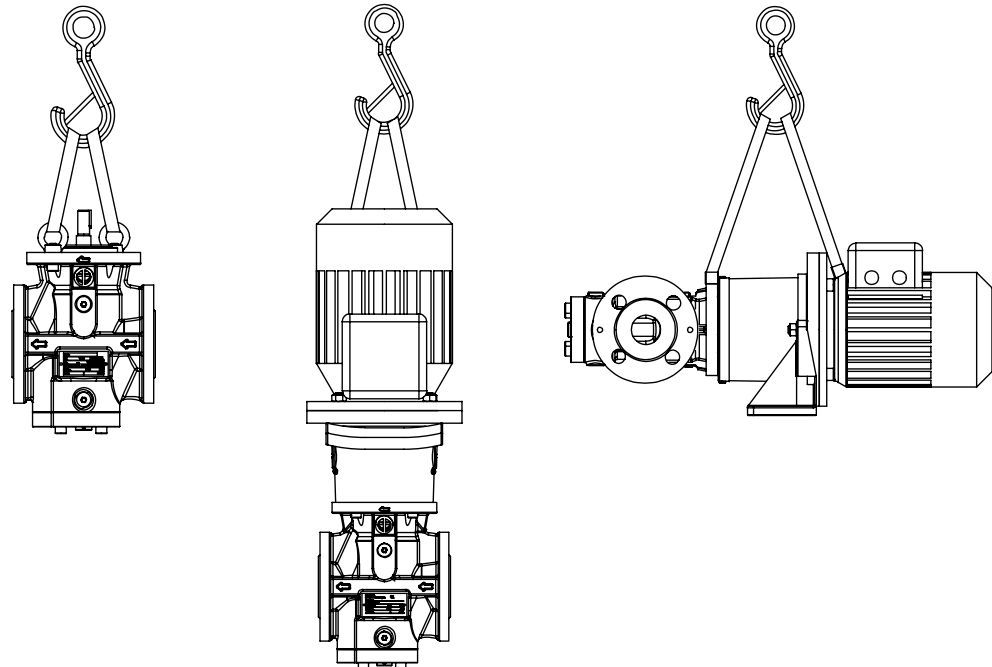


Fig. 5: Fastening of hoisting equipment - principle diagrams

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

7 Preservation

7.1 Preservation table

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 12.

7 Preservation

7.1 Preservation table

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

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

Tab. 8: Conditions for additional preservation

7.2 Preserving the inner surfaces

Personnel qualification:	<input type="checkbox"/> Trained personnel
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Preservative (acid-free and resin-free oil)

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:	<input type="checkbox"/> Trained personnel
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Face protection <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Calcium complex grease (for example TEVI-ER® GREASE WAVE 100 with adhesive additive) <input type="checkbox"/> Castrol Rustilo DWX 33 or other preservative offering comparable protection

1. ▶ Brush calcium complex grease corrosion protection (for example TEVI-ER® FETT WAVE 100 with adhesive additive) to the mounting surfaces.
2. ▶ Brush or spray preservative (for example Castrol Rustilo DWX 33) onto the process connections and remaining plain and unpainted parts.
3. ▶ At intervals of about six months check the preservation and if necessary repeat.

7.4 Removing the preservation

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



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 35.
- 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:	<input type="checkbox"/> Transport personnel <input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective helmet

8 Installation, removal

8.4 Removing the pump

	<input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Mobile crane, forklift, hoisting equipment



WARNING

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

- ▶ Only fasten the pump 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.

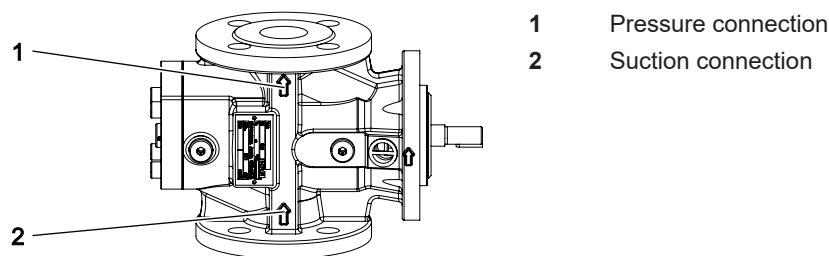


Fig. 6: Flow direction

Requirement:

- ✓ Pump protection: Integrated overflow valve or system-side overflow valve/safety valve installed.
 - ✓ 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 arrows for the flow direction on the pump housing (1 pressure connection, 2 suction connection).
 2. ▶ Fasten the pump with fastening elements securely on the underground.

8.4 Removing the pump

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

**⚠ DANGER****Risk of death resulting from electric shock.**

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

**⚠ DANGER****Risk of death 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 10.

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 35.
- 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 Connecting the pump to the pipe system

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

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.

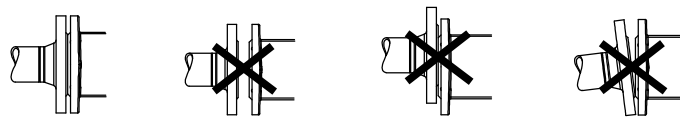


Fig. 7: Connection to pipe system

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 31.
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 35.

9.3 Insulating the pump

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



⚠ 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.

9.4 Assembling the pump and motor

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

ATTENTION**Damage to coupling and bearing through incorrect alignment of the coupling.**

- ▶ To guarantee a long service life of the coupling, align shaft ends exactly.
- ▶ After assembly check permissible displacement figures of the coupling according to table below.

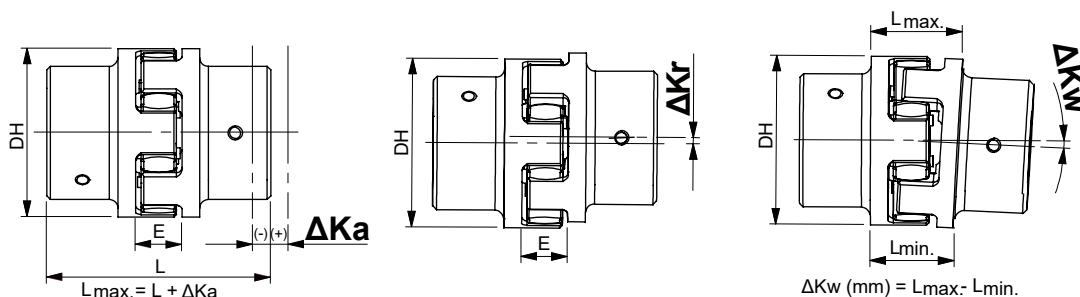


Fig. 8: Coupling alignment measuring points

Outer diameter DH [mm]	Coupling distance E [mm]	Max. axial displacement ΔK_a [mm]	Max. radial displacement ΔK_r [mm]	Max. angular displacement ΔK_w [°]	
55	18	-0.5/ +1.4	0.22	0.9	0.9
65	20	-0.7/ +1.5	0.25	0.9	1.1
80	24	-0.7/ +1.8	0.28	1.0	1.4
95	26	-1.0/ +2.0	0.32	1.0	1.7

Tab. 9: Limit values for aligning the shaft coupling

1. ▶ Check the radial displacement ΔK_r of the coupling using a hairline gauge and feeler gauge. Check several points along the periphery of the coupling.
2. ▶ Check the angular displacement ΔK_w of the coupling using a hairline gauge.
3. ▶ Check the axial displacement ΔK_a of the coupling using a slide gauge or feeler gauge.
4. ▶ If the limit values of the above table are exceeded, loosen the fastening of the pump or motor and move pump or motor in order to reduce the respective offset.

9.5 Connecting the pump unit to the power supply

Personnel qualification:	<input type="checkbox"/> Electrician
Aids:	<input type="checkbox"/> Operating instructions of the motor <input type="checkbox"/> 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.

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

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

Possibilities

There are two possible ways to fill the pump:

- Via the suction connection or pressure connection
- Via the vent holes

Filling and venting the pump via the suction connection or pressure connection

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

- Safety boots
- Face protection

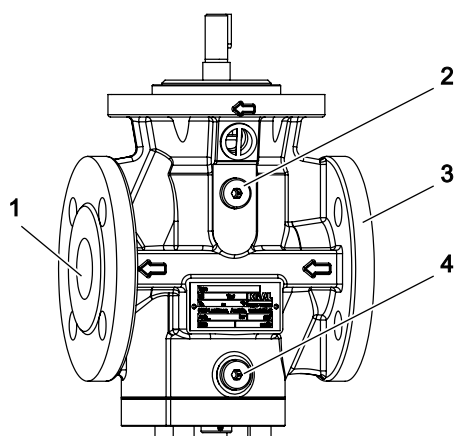


⚠ DANGER

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 Pressure connection
- 2 Pressure-side vent hole
- 3 Suction connection
- 4 Suction-side vent hole

1. ▶ Open the screw plug of the vent hole **2** or **4** by a max. of two rotations so that air can escape during the filling process.
2. ▶ Open the suction-side or pressure-side shut-off device and fill the pump via the suction connection **3** or pressure connection **1** until pumped liquid is emitted at the vent hole **2** or **4**.
3. ▶ During the filling process turn the pump shaft or the fan impeller of the motor by hand to speed up the filling process:
 Filling via the suction connection: Turn the pump shaft in the direction of the arrow of the pump flange.
 Filling via the pressure connection: Turn the pump shaft against the direction of the arrow on the pump flange.
4. ▶ Retighten the screw plug of the vent hole **2** or **4**.

Filling and venting the pump via the vent hole

Note Filling the pump via the vent hole only makes sense in the horizontal mounting position.

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



⚠ 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:

10 Operation

10.2 Commissioning

- ✓ Shut-off devices in the suction line and pressure line closed
- 1. ➤ Remove the screw plug of the vent hole **1** and **2** so that the air can escape during the filling process.
- 2. ➤ Fill the pump via one of the vent holes until pumped liquid is emitted at the second vent hole.
- 3. ➤ During the filling process turn the pump shaft or the fan impeller of the motor by hand to speed up the filling process:
 - Filling via the suction-side vent hole: Turn the pump shaft in the direction of the arrow on the pump flange.
 - Filling via the pressure-side vent hole: Turn the pump shaft against the direction of the arrow on the pump flange.
- 4. ➤ Retighten the screw plugs of the vent hole **1** and **2**.

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)

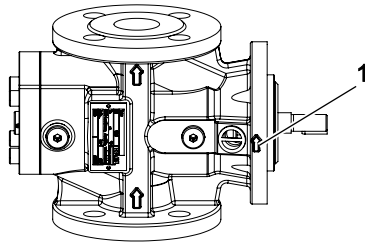
Personnel qualification:	<input type="checkbox"/> Fitter
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ATTENTION

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



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

Danger of injury through rotating parts.

- ▶ Ensure that the coupling protection is mounted.

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
 - ✓ Coupling aligned correctly ↪ Connection, Page 15
 - ✓ 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.
 - ✓ Pump filled with pumped liquid
 - ✓ Shut-off devices in the suction line and pressure line opened
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. ↪ Troubleshooting, Page 31
 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.

10 Operation

10.3 During operation

- ▶ If the pump does not deliver after 10 – 15 seconds of operation, abort commissioning. Eliminate the cause of the fault and only then continue with commissioning. Take the information from the troubleshooting table into account ↪ Troubleshooting, Page 31.
- ▶ 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.
- ▶ Checking overflow valve functions ↪ During operation, Page 22.

10.3 During operation

10.3.1 Checking the operating pressure

Personnel qualification: Trained personnel

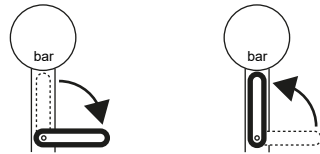


Fig. 9: Pressure gauge shut-off valves closed/open - principle diagram

ATTENTION

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

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

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

10.3.2 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

- ▶ 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.
- ▶ 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.
- ▶ Check the suction-side pressure every two weeks during operation.
- ▶ Regularly check the magnetic separator in the filter/strainer during operation and clean it if necessary.

10.3.3 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.

- ▶ Switch off the motor.
- ▶ 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:	<input type="checkbox"/> Fitter <input type="checkbox"/> Electrician
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Collection tank



WARNING

Risk of injury through emitted pumped liquid.

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

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

ATTENTION

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
<input type="checkbox"/> Shutting down the pump for a longer period	—▶ Depending on the pumped liquid
<input type="checkbox"/> Draining the pump	—▶ Close the pressure-side and suction-side shut-off devices.
<input type="checkbox"/> Dismantling the pump	—▶ Disconnect the motors from the power supply and secure against being switched back on.
<input type="checkbox"/> Storing the pump	—▶ Observe measures for storing and preservation ↪ Transportation, storage, Page 10.

Tab. 10: Measures during operation interruptions

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

Tab. 11: 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 18.

11 Maintenance

11.1 Dangers during maintenance



The following safety instructions must be observed strictly:

- Have all work carried out only by authorized qualified personnel.
- Before beginning work, let the pump 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
Pump	<input type="checkbox"/> Visual inspection <input type="checkbox"/> Acoustic inspection	4 weeks
Leakage vent hole	<input type="checkbox"/> Visual inspection <input type="checkbox"/> If required, clean	4 weeks
Filter/strainer (system side)	<input type="checkbox"/> Check of the suction-side pressure	2 weeks
Overflow valve	<input type="checkbox"/> Function test	≤ 5 years

Tab. 12: Required maintenance

11.3 Ball bearing

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

11.4 Maintaining the pump

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



⚠ WARNING

Risk of injury through emitted pumped liquid.

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

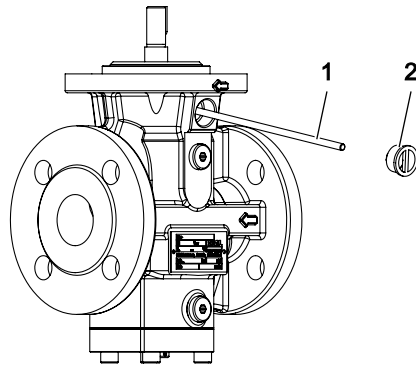
- ▶ Wear personal protective clothing during all the work. Ensure face protection.
- ▶ Collect any discharging pumped liquid safely and dispose of it in an environmentally compatible manner in accordance with the applicable local regulations.

1. ➤ Check the pump visually and acoustically every four weeks.
2. ➤ If there are signs of wear, eliminate the cause ↪ Servicing, Page 25.

11.5 Cleaning the leakage vent hole

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

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



1. ➤ Remove the safety plug **2** from the leakage vent hole.
-or-
If a leakage vent hole is connected, unscrew the leakage vent line.
2. ➤ To check the permeability of the leakage vent hole insert a flexible soft arbour **1** into the leakage vent hole.
3. ➤ In case of insufficient permeability clean the leakage vent hole and if existing the leakage vent line.
4. ➤ Close the leakage vent hole with the safety plug **2**
-or-
If existing, reconnect the leakage vent line.

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 35.
- 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.
Increased leaking	Incipient damage to seal	—► Replace the shaft seal.
Deposits at the shaft seal	Low-volatile liquids	—► Clean the shaft seal.
Increased play in the coupling	Advanced wear of the coupling intermediate ring	—► Replace the coupling intermediate ring.
Reduction in the delivery rate or pressure under constant operating conditions	Advanced wear of screws and housing	—► Replace the pump.

Tab. 13: Signs of wear

12.2.2 Mechanical seal

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

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

12.3 Replacing the coupling

12.3.1 Removing the coupling

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



WARNING

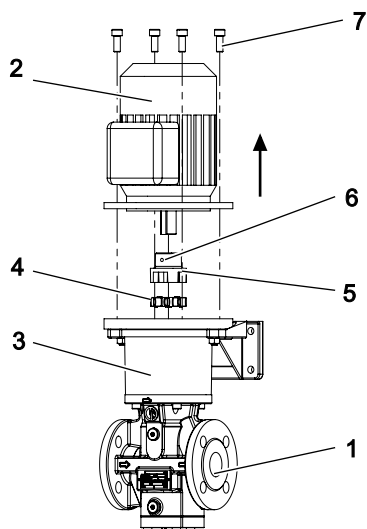
Risk of injury and damage to equipment through falling and toppling parts.

- 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 tipping.
- Do not stand under raised loads.

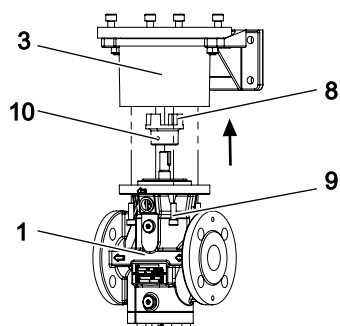
Requirement:

✓ Pump unit disconnected from the electrical power supply

1. ► Before dismantling close the suction connection and pressure connection of the pump with protective covers.
2. ► Fixate the pump unit with suitable measures.



3. ➤ Attach the hoisting equipment to the motor 2.
4. ➤ Loosen the socket screws 7 between the motor 2 and the pump bracket 3.
5. ➤ Lift the motor 2 off the pump bracket 3.
6. ➤ Loosen the fixing screw 6 at the motor-side coupling half 5.
7. ➤ Remove the coupling intermediate ring 4 and pull off the coupling half 5 using a suitable tool.



8. ➤ Remove the socket screws 9 between the pump 1 and pump bracket 3 and remove the pump bracket.
9. ➤ Loosen the fixing screw 10 at the pump-side coupling half 8 and pull off the coupling half using a suitable tool.

12.3.2 Installing the coupling

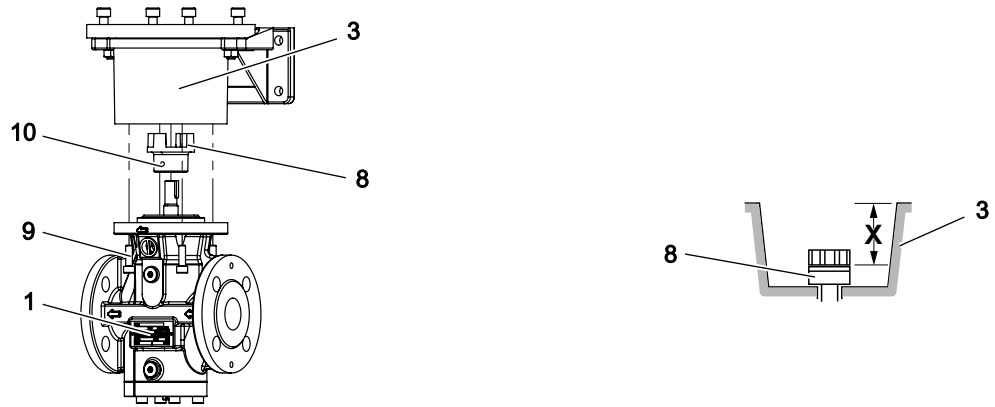
Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Measuring stick <input type="checkbox"/> Silicone oil <input type="checkbox"/>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

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

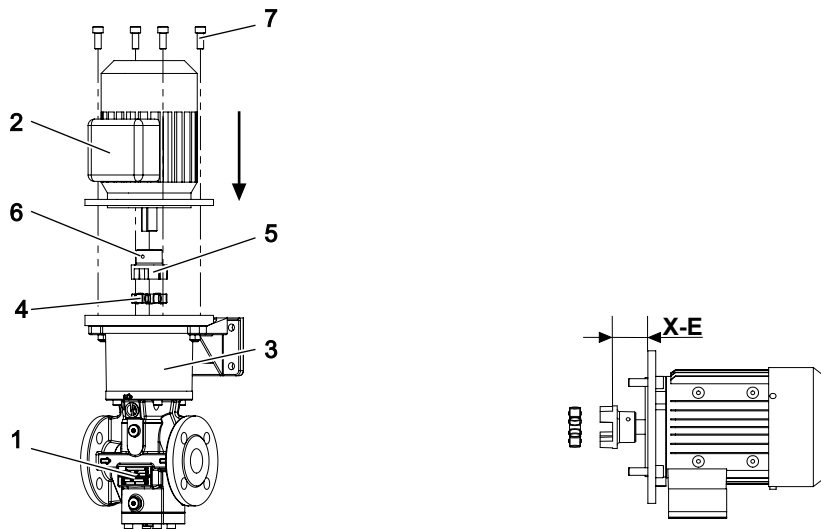
1. ➤ Oil the shaft of the pump with silicone oil.

12 Servicing

12.4 Replacing the mechanical seal and ball bearing



2. ➤ Slide the pump-side coupling half **8** onto the shaft until it stops.
3. ➤ Tighten the fixing screw **10** of the pump-side coupling half **8**.
4. ➤ Place the pump bracket **3** on the pump **1** and tighten the socket screws **9** with torque.
5. ➤ Measure and write down the distance **X** between the face of the coupling claws and the connecting surface of the pump bracket **3**.



6. ➤ Tighten the motor-side coupling half **5** on the shaft end of the motor **2**.
7. ➤ Check the distance between the face of the coupling teeth and the connecting surface of motor flange. The distance has to be adjusted to the value **X-E**, table coupling alignment ↪ Connection, Page 15.
8. ➤ Tighten the fixing screw **6** on the motor-side coupling half **5** and insert the coupling intermediate ring **4**.
9. ➤ Attach the hoisting equipment to the motor **2** and position it above the pump **1**.
10. ➤ Place the motor **2** on the pump bracket **3** of the pump **1**.
11. ➤ Turn the pump slightly until the teeth of the pump-side coupling half **8** meshes correctly into the spaces of the coupling intermediate ring **4**.
12. ➤ Tighten the socket screws **7** between the motor **2** and pump bracket **3** with torque.

12.4 Replacing the mechanical seal and ball bearing

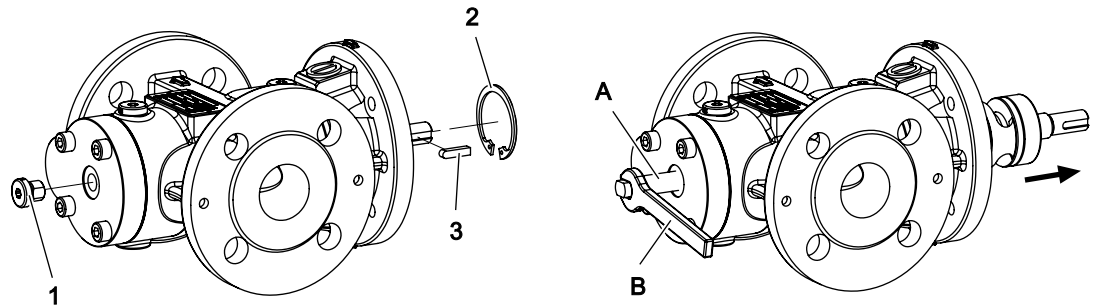
12.4.1 Removing the mechanical seal and ball bearing

Note For secure disassembly the manufacturer recommends the disassembly tool from the mechanical seal maintenance kit. The maintenance kit is available from the manufacturer.

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

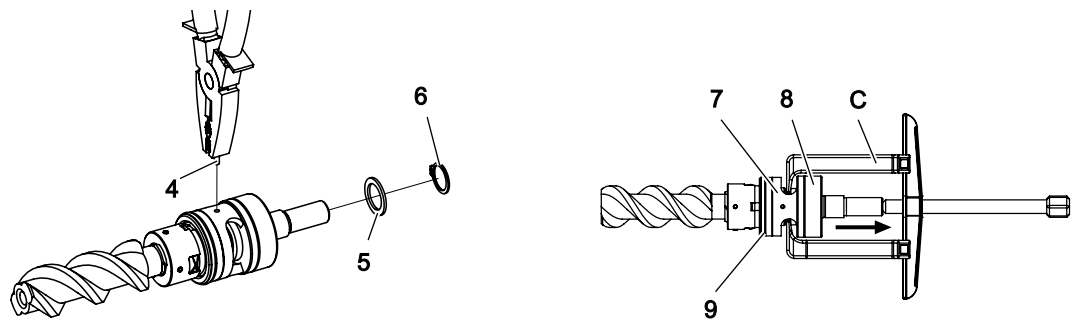
12.4 Replacing the mechanical seal and ball bearing

Aids:	<input type="checkbox"/> Extractor <input type="checkbox"/> Disassembly tool <input type="checkbox"/> Open-end spanner <input type="checkbox"/> Plastic hammer <input type="checkbox"/> Pliers
-------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

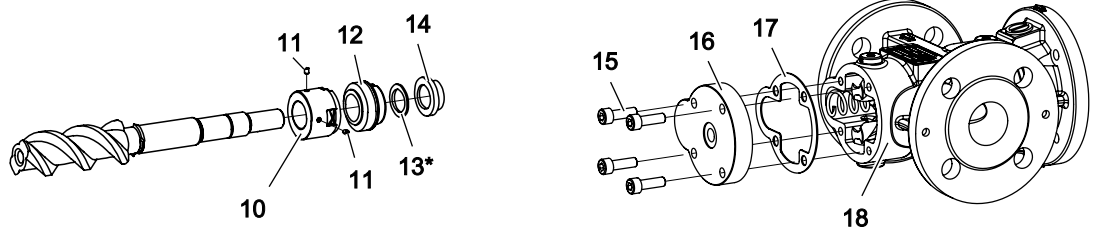


* Part of the maintenance kit

1. ➤ Remove the circlip **2**, screw plug **1** and feather key **3**.
2. ➤ Screw in the disassembly tool **A*** with open-end spanner **B**.
 ⇒ The main screw is pressed out of the pump housing.
3. ➤ Pull the main screw out of the pump housing.



4. ➤ Remove the circlip **6** and supporting ring **5**, remove the adapter sleeve **4** with pliers.
5. ➤ Remove the ball bearing **8** and sealing sleeve **7** with O-ring **9** from the main screw with a suitable extractor **C**.



* Only for Size 15–20

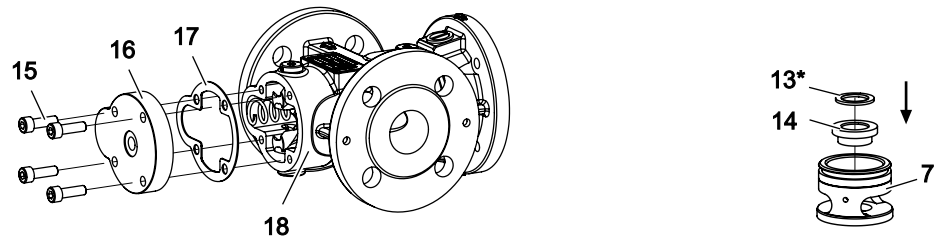
6. ➤ Remove the L-ring **14**, supporting ring **13*** as well as stationary seal ring of the mechanical seal **12**.
7. ➤ Loosen the threaded pins **11** and remove the remaining parts of the mechanical seal from the main screw.
8. ➤ Remove the socket screws **15** and remove the end cover **16** using light "rebound" blows. Remove the residues of the flat gasket **17** from the end cover and pump housing.

12.4.2 Installing the mechanical seal and ball bearing

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots
Aids:	<input type="checkbox"/> Tool set, mechanical seal ↪ Spare parts, Page 34

12 Servicing

12.4 Replacing the mechanical seal and ball bearing



* Only for Size 15–20

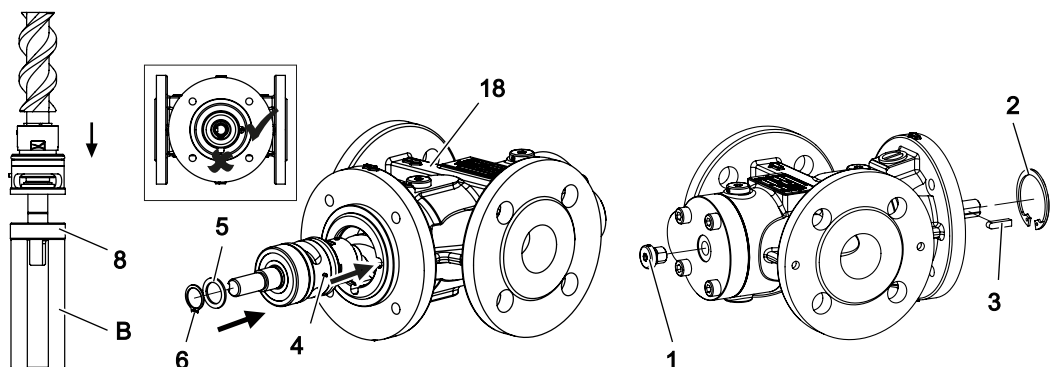
1. Carefully clean the sealing surfaces of the pump housing **18** and the end cover **16**.
2. With the socket screws **15** fasten the new flat gasket **17** and end cover **16** onto the pump housing **18**. Tighten the socket screws with torque ↪ Appendix, Page 35.
3. Clean the fitting surfaces and the main screw. Lightly grease the main screw and O-rings.
4. Insert the L-ring **14** and supporting ring **13*** into the sealing sleeve **7**.



5. Knock the adapter sleeve **4** into the opening of the sealing sleeve **7**. In the process observe the required distance **x** in accordance with the table.
6. Press in the stationary seal ring **12** of the mechanical seal by hand into the sealing sleeve **7**. Observe the position of the adapter sleeve **4**.



7. Slide the rotary ring **10** onto the main screw **19**. In the process use the mounting sleeve mechanical seal **A**.
8. Tighten the threaded pins **11**.
9. Clean the sealing surfaces of the mechanical seal.
10. Slide the new O-ring **9** onto the sealing sleeve **7** and slide the sealing sleeve with the remaining parts of the mechanical seal onto the main screw **19**.



11. Press the ball bearing **8** onto the main screw. In the process use the mounting sleeve ball bearing **B**.
12. Mount the supporting ring **5** and circlip **6**.
13. Slide the main screw with premounted mechanical seal and ball bearing into the pump housing until the main screw engages into the idle screws. Rotate the main screw and observe the position of the clearance for the adapter sleeve **4**.
14. Mount the screw plug **1**, circlip **2** and feather key **3**.

Size	Required distance x	
	min. [mm]	max. [mm]
15-20	3.0	3.5
32-210	5.0	5.5

Tab. 14: Required distance adapter sleeve

13 Disposal

13.1 Dismantling and disposing of the pump

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



WARNING

Danger of poisoning and environmental damage through residues.

- ▶ Wear personal protective clothing during all the work. Ensure face protection.
- ▶ Before disposal collect any pumped 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.

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

14 Troubleshooting

14.2 Troubleshooting

14.2 Troubleshooting

Fault identification							Cause	Remedy
1	-	-	-	-	-	-	Pump suction line closed	<ul style="list-style-type: none"> —> Check the shut-off devices. If required, open.
1	2	3	-	5	-	-	Parts soiled (filter, suction line, suction valve, strainer)	<ul style="list-style-type: none"> —> Clean parts.
1	2	3	-	5	-	-	Suction head too high	<ul style="list-style-type: none"> —> 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	<ul style="list-style-type: none"> —> Fill the intake container.
1	-	-	-	-	-	-	Too little pumped liquid in the pump	<ul style="list-style-type: none"> —> Fill the pump with pumped liquid.
1	-	-	-	-	-	-	Incorrect pump direction of rotation	<ul style="list-style-type: none"> —> Swop the two electrical connection phases ↪ Connection, Page 15.
-	-	-	4	-	-	-	Differential pressure too high	<ul style="list-style-type: none"> —> Reduce the differential pressure.
1	-	3	4	5	-	-	Viscosity of the pumped liquid too high	<ul style="list-style-type: none"> —> Increase the temperature of the pumped liquid. -or- Decrease the speed.
-	2	-	-	-	-	-	Viscosity of the pumped liquid too low	<ul style="list-style-type: none"> —> Reduce the temperature of the pumped liquid. -or- Increase the speed.
-	2	3	-	5	-	-	Airlock/gas in the pumped liquid	<ol style="list-style-type: none"> 1. —> Test the pipe system for air admission, replace leaking parts. 2. —> Reduce the suction head. <ul style="list-style-type: none"> -or- Increase the inlet pressure.
-	2	-	4	-	-	-	Speed/frequency/voltage of the motor false	<ol style="list-style-type: none"> 1. —> Ensure that the motor frequency and voltage match the operating voltage. 2. —> Ensure that the speed of the motor matches the rating plate of the pump. If necessary adjust the speed.
-	2	3	-	5	-	-	Overflow valve opens during normal operation	<ul style="list-style-type: none"> —> Set the opening pressure to 110% of the differential pressure ↪ During operation, Page 22.
-	2	-	-	5	-	-	Overflow valve leaks	<ul style="list-style-type: none"> —> Contact the manufacturer.
-	2	-	-	-	-	-	Advanced wear of the housing/screw set	<ul style="list-style-type: none"> —> Contact the manufacturer.
-	-	-	-	-	-	7	Advanced wear of sealing surfaces	

Fault identification						Cause	Remedy
							<ul style="list-style-type: none"> —> Replace the seal and check the pumped liquid for abrasive substances. If required, replace the filter/strainer. -or- Contact the manufacturer.
-	-	3	-	-	-	Coupling aligned incorrectly	<ul style="list-style-type: none"> —> Assemble the coupling and motor correctly ↪ Connection, Page 15
-	-	3	-	-	-	Pump subject to mechanical stress	<ul style="list-style-type: none"> —> Connect the pump correctly to the pipe system ↪ Connection, Page 15.
-	-	3	-	-	-	Vibrations/pulsations in the system	<ul style="list-style-type: none"> —> Bear the pump unit elastically. -or- Make the connections with hoses.
-	-	3	-	-	-	Flow speed in the pressure line or suction line too high	<ul style="list-style-type: none"> —> Set the flow speed in the pressure line so that it does not exceed 3 m/s. -or- Set the flow speed in the suction line so that it does not exceed 1 m/s. -or- Contact the manufacturer.
-	-	3	4	-	7	Ball bearing damaged	<ul style="list-style-type: none"> —> Replace the ball bearing ↪ Servicing, Page 25.
-	2	3	4	-	7	Superficial damage to pump parts coming into contact with the liquid	<ul style="list-style-type: none"> —> Contact the manufacturer.
-	-	-	-	-	7	Shaft seal damaged through dry running	<ul style="list-style-type: none"> —> Replace the shaft seal ↪ Servicing, Page 25.
-	-	-	-	-	7	Inlet pressure too high	<ol style="list-style-type: none"> 1. > Reduce the inlet pressure at the system side. 2. > Replace the shaft seal ↪ Servicing, Page 25.
-	-	-	-	-	7	Inlet pressure too low	<ul style="list-style-type: none"> —> Install a non-return valve at the pressure side.
-	-	-	-	-	7	Shaft seal is overloaded through thermal/chemical influences	<ol style="list-style-type: none"> 1. > Check the maximum operating temperature. 2. > Check the suitability and resistance of the elastomers with regard to the pumped liquid. <ul style="list-style-type: none"> -or- Contact the manufacturer.
-	-	-	-	-	7	Overload of the shaft seal by pressure build-up during the heating process	<ul style="list-style-type: none"> —> Open the pressure-side/suction-side shut-off device in order to avoid a pressure build-up through heat expansion of the pumped liquid.
1	2	3	4	5	-	Cold start when delivering high-viscosity liquids	<ul style="list-style-type: none"> —> Install the heating system.
-	-	-	4	-	7	Foreign bodies in the pump	<ul style="list-style-type: none"> —> Contact the manufacturer.
-	-	-	-	-	7	Differential pressure is too high and has overloaded the idle screws	<ul style="list-style-type: none"> —> Contact the manufacturer.
-	-	-	-	-	7	Viscosity is too low and has overloaded the idle screws	<ul style="list-style-type: none"> —> Contact the manufacturer.
1	2	3	4	-	7	Pump damaged through dry running	<ul style="list-style-type: none"> —> Contact the manufacturer.
1	-	-	-	-	-	Pump does not vent	<ul style="list-style-type: none"> —> Vent the pressure line at the highest point.

Tab. 15: Fault table

15 Spare parts

15.1 Overview

Model/Size	Type	Variant	Internal
15 – 210	Maintenance kit	Mechanical seal	OPW 33
15 – 210	Tool set	Mechanical seal standard/hard material, ball bearing	OPT 04

Tab. 16: Overview of spare parts

15.2 Maintenance kits

15.2.1 Maintenance kit mechanical seal

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

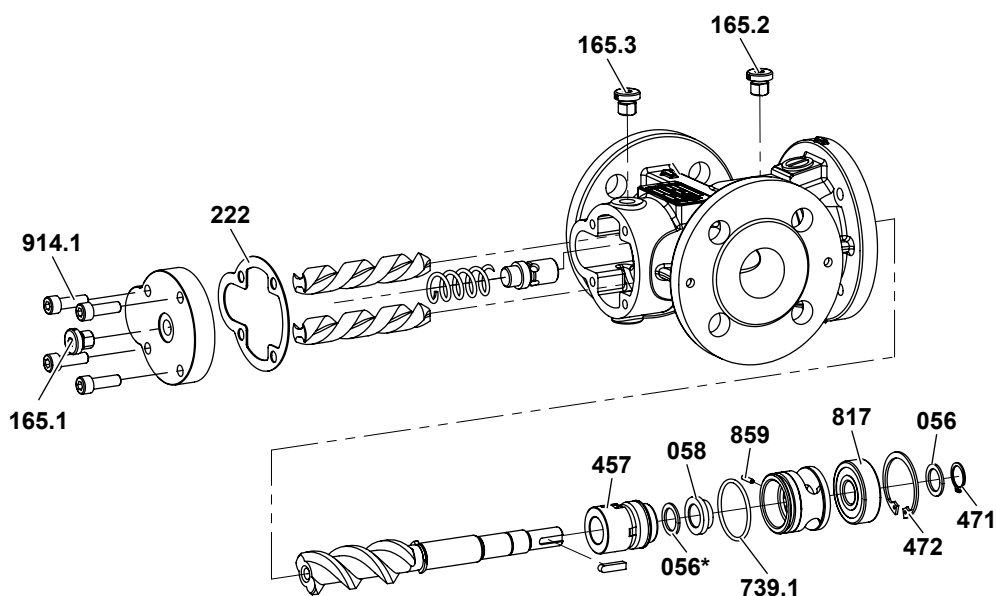


Fig. 10: Maintenance kit RFI

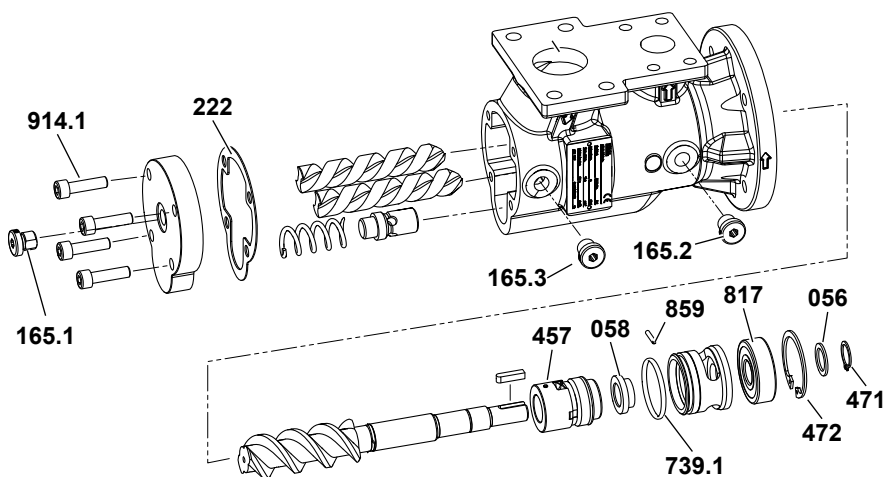


Fig. 11: Maintenance kit RFT


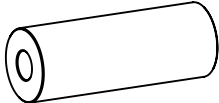
Qty.	Item No.	Part	Qty.	Item No.	Part
1 (2*)	056(*)	Supporting ring	1	472	Circlip
1	058	L-ring	1	739.1	O-ring
1	165.1	Screw plug	1	817	Ball bearing
1	165.2	Screw plug	1	859	Adapter sleeve

Qty.	Item No.	Part	Qty.	Item No.	Part
1	165.3	Screw plug	4	914.1	Socket screw
1	222	Flat gasket	1		Silicone grease 1 g
1	457	Mechanical seal	1		Disassembly tool
1	471	Circlip			
	*	Only for R 15–20			

Tab. 17: Maintenance kit mechanical seal

15.3 Tool sets

15.3.1 Tool set, mechanical seal

	Qty.	Part
	1	Mounting sleeve main screw
	1	Mounting sleeve ball bearing

Tab. 18: Tool set, mechanical seal

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

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

Tab. 19: 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. 20: Tightening torques with thread measured in inches

16.3 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. 21: Directives observed



KRAL

