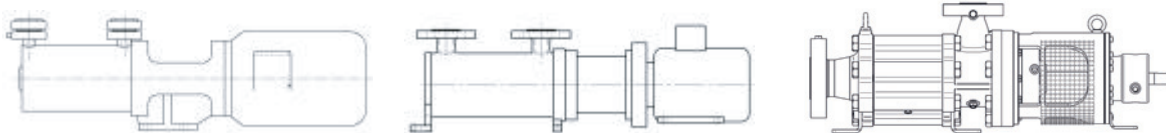
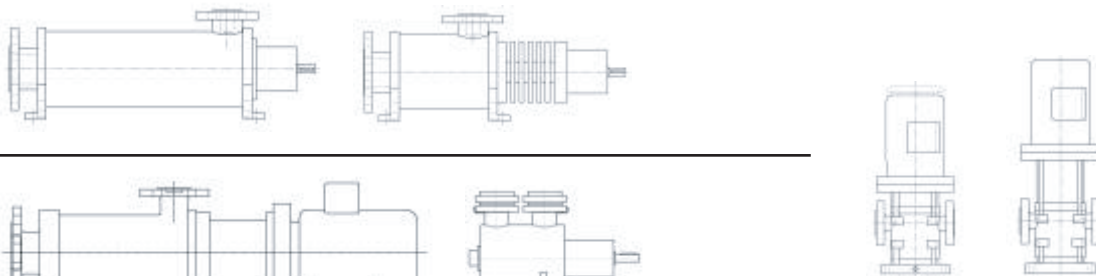


Side channel pump

Original Operating Manual

**SON, SOB, SRN, SRB, SRBS
SOH, SOHB, SFH, SOR, SVG
SRZ, SRZS, SHP
SOHM, SVM
SEMA-L, SEMA-Z, SEMA-S**



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Read carefully before use.
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1 About this document

This manual:

- Is part of the pump
- Applies to the pump series mentioned above
- Describes safe and appropriate operation during all operating phases

1.1 Target groups

Target group	Duty
Operating company	<ul style="list-style-type: none"> ▶ Keep this manual available at the site of operation of the equipment, including for later use. ▶ Ensure that personnel read and follow the instructions in this manual and the other applicable documents, especially all safety instructions and warnings. ▶ Observe any additional rules and regulations referring to the system.
Qualified personnel, fitter	<ul style="list-style-type: none"> ▶ Read, observe and follow this manual and the other applicable documents, especially all safety instructions and warnings.

Tab. 1 Target groups and their duties





1.2 Other applicable documents

Document	Purpose
Data sheet/performance curve	Technical specifications, conditions of operation
Dimension drawing ¹⁾	Setup dimensions, connection dimensions etc.
Delivery note	Details on scope of delivery, weight, etc.
Sectional drawing, spare parts list ¹⁾	Ordering spare parts
Supplier documentation	Technical documentation for parts supplied by subcontractors
Declaration of conformity, declaration of installation	Conformity with standards, contents of the declarations of conformity and installation (→ 9.3 Declarations according to EC machine directives, Page 43).



Tab. 2 Other applicable documents and their purpose

1) Can be subsequently ordered if necessary.

1.3 Warnings and symbols

Warning	Risk level	Consequences of disregarding the warning
	Immediate acute risk	Death, serious bodily harm
	Potential acute risk	Death, serious bodily harm
	Potentially hazardous situation	Minor bodily harm
	Potentially hazardous situation	Material damage

Tab. 3 Warnings and consequences of disregarding them

Symbol	Meaning
	Safety warning sign ▶ Take note of all information highlighted by the safety warning sign and follow the instructions to avoid injury or death.
▶	Instruction
1. , 2. , ...	Multiple-step instructions
✓	Precondition
→	Cross reference
	Information, notes


Tab. 4 Symbols and their meaning

1.4 Technical terms

Term	Meaning
Sealing medium	Medium for blocking or quenching shaft seals
Auxiliary operating systems	Systems for operating the pump

Tab. 5 Technical terms and their meaning

2 Safety

 The manufacturer does not accept any liability for damages caused by disregarding the entire documentation.

2.1 Intended use


- Only use the pump to pump the agreed pumped liquids (→ data sheet/performance curve).
- Adhere to the operating limits and size-dependent minimum flow rate (→ data sheet/performance curve).
- Avoid dry running:
 - Initial damage, such as destruction of seals and plastic parts, will occur within only a few seconds.
 - Make sure the pump is only operated with, and never without, pumped liquid.
- Avoid cavitation:
 - Open the suction-side fitting completely.
 - Do not open the pressure-side fitting beyond the agreed operating point (→ data sheet/performance curve).
- Avoid overheating:
 - Do not operate the pump while the pressure-side fitting is closed.
 - Observe the minimum flow rate (→ data sheet/performance curve).
- Avoid damage to the motor:
 - Do not close the pressure-side fitting beyond the agreed operating point.
 - Note the maximum permissible number of times the motor can be switched on per hour (→ manufacturer's specifications).
- Avoid excessive pressure:
 - Do not operate the pump while the pressure-side fitting is closed.
 - Secure the pump in the pressure-side pipe against overpressure to prevent damage by exceeding the maximum permissible housing pressure (nominal pressure) or maximum pressure at the mechanical seal. This is especially true for operation with a variable speed (→ 5.1.2 Plan operation of pump with changing speed, Page 20).
- Consult the manufacturer about any other use of the pump.

Prevention of obvious misuse (examples)

- Note the operating limits of the pump concerning temperature, pressure, flow rate and motor speed (→ data sheet/performance curve).
- The power consumed by the pump increases with increasing density of the pumped medium. To avoid overloading the pump, coupling or motor, stay within the agreed density (→ data sheet/performance curve). Lower densities are allowed. Adapt the auxiliary systems accordingly.
- When using auxiliary systems, ensure there is a continuous supply of the appropriate operating medium.

- Pumps may not be used with foodstuffs if they have not been adapted accordingly. The use of the pump for foodstuffs must be specified in the data sheet/performance curve.
- Only select the setup type according to this operating manual. For example, the following are not allowed:
 - Hanging base plate pumps in the pipe
 - Overhead installation
 - Installation in the immediate vicinity of extreme heat or cold sources
 - Installation too close to the wall

2.2 General safety instructions

 Observe the following regulations before carrying out any work.

2.2.1 Product safety

The pump has been constructed according to the latest technology and recognized technical safety rules. Nevertheless, operation of the pump can still put the life and health of the user or third parties at risk or damage the pump or other property.

- Only operate the pump if it is in perfect technical condition and only use it as intended, remaining aware of safety and risks, and in adherence to the instructions in this manual.
- Keep this manual and all other applicable documents complete, legible and accessible to personnel at all times.
- Refrain from any procedures and actions that would pose a risk to personnel or third parties.
- In the event of any safety-relevant malfunctions, shut down the pump immediately and have the malfunction corrected by the personnel responsible.
- In addition to the entire documentation for the product, comply with statutory or other safety and accident-prevention regulations and the applicable standards and guidelines in the country where the pump is operated.

2.2.2 Obligations of the operating company

Safety-conscious operation

- Only operate the pump if it is in perfect technical condition and only use it as intended, remaining aware of safety and risks, and in adherence to the instructions in this manual.
- Ensure that the following safety aspects are observed and monitored:
 - Adherence to intended use
 - Statutory or other safety and accident-prevention regulations
 - Safety regulations governing the handling of hazardous substances
 - Applicable standards and guidelines in the country where the pump is operated
- Make personal protective equipment available.

Qualified personnel

- Make sure all personnel tasked with work on the pump have read and understood this manual and all other applicable documents, especially the safety, maintenance and repair information, before they start any work.
- Organize responsibilities, areas of competence and the supervision of personnel.
- Ensure that all work is carried out by specialist technicians only:
 - Fitting, repair and maintenance work
 - Work on the electrical system
- Make sure that trainee personnel only work on the pump under the supervision of specialist technicians.
- Persons who have an implanted pacemaker:
 - Must stay away from the pump with magnetic coupling and parts of the magnetic coupling
 - May not work on or with any of the magnetic parts

Safety equipment

- Provide the following safety equipment and verify its functionality:
 - For hot, cold and moving parts: Safety guarding provided by the customer for the pump
 - For possible build up of electrostatic charge: Ensure appropriate grounding

Warranty

- Obtain the manufacturer's approval prior to carrying out any modifications, repairs or alterations during the warranty period.
- Only use genuine parts or parts that have been approved by the manufacturer.

2.2.3 Obligations of personnel

- All directions given on the pump must be followed (and kept legible), e.g. the arrow indicating the sense of rotation and the markings for fluid connections.
- Pump, contact guard and components:
 - Do not step on them or use as a climbing aid
 - Do not use them to support boards, ramps or beams
 - Do not use them as a fixing point for winches or supports
 - Do not use them for storing paper or similar materials
 - Do not use hot pump or motor components as a heating point
 - Do not de-ice using gas burners or similar tools
- Do not remove the safety guarding for hot, cold or moving parts during operation.
- Use personal protective equipment whenever necessary.
- Only carry out work on the pump while it is not running.
- Isolate the motor from its supply voltage and secure it against being switched back on again before all assembly and maintenance work.
- Reinstall the safety equipment on the pump as required by regulations after any work on the pump.
- With an implanted pacemaker:
 - Stay at least 1 meter away from the pump with magnetic coupling or parts of the magnetic coupling.
 - Do not work with or on the magnetic parts.

2.3 Specific hazards

2.3.1 Explosion-hazard area

- (→ 9.5 ATEX additional instructions, Page 46).

2.3.2 Hazardous pumped liquids

- Follow the safety regulations for handling hazardous substances when handling hazardous (e.g. hot, flammable, poisonous or potentially harmful) pumped liquids.
- Use personal protective equipment when carrying out any work on the pump.

2.3.3 Magnetic field

The magnetic field of the magnetic coupling can destroy products that are sensitive to magnets. These include:

- Pacemakers
- Plastic identity cards with magnetic strips
- Credit and check cards
- Electric, electronic and precision mechanical devices (such as mechanical and digital clocks, pocket calculators, hard disks)

3 Layout and function

3.1 Label

3.1.1 Type plate

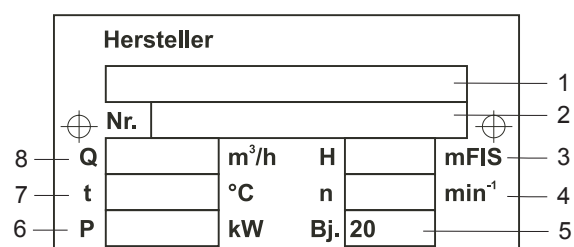


Fig. 1 Type plate (example)







- 1 Name
- 2 Serial number
- 3 Differential head
- 4 Motor speed
- 5 Year of manufacture
- 6 Power consumption (pump)
- 7 Max. pumped liquid temperature
- 8 Flow rate

3.1.2 Pump type code

- SON...W, SON...WW
 - Self-priming side channel pump PN 16, capable of handling aerated fluids (light-weight version)
 - Horizontal, single-stage or multi-stage
 - Base plate version (pump and motor on shared base plate)
- SOB...W
 - Self-priming side channel pump PN 16, capable of handling aerated fluids (light-weight version)
 - Horizontal, single-stage or multi-stage
 - Block version with flange-mounted motor
- SRN...WW
 - Self-priming side channel pump PN 25, capable of handling aerated fluids (medium-weight version)
 - Horizontal, single-stage or multi-stage
 - Base plate version (pump and motor on shared base plate)
- SRB...WW
 - Self-priming side channel pump PN 25, capable of handling aerated fluids (medium-weight version)
 - Horizontal, single-stage or multi-stage
 - Block version with flange-mounted motor
- SRBS...W
 - Multifunction pump – pump combining a side channel pump and a centrifugal pump
 - Side channel pump PN 25, capable of handling aerated fluids (medium-weight version)
 - Horizontal, single-stage and multi-stage
 - With upstream suction impeller and axial suction branch to achieve lower NPSH values
 - Block version with flange-mounted motor
- SOH...W
 - Self-priming side channel pump PN 16, capable of handling aerated fluids (light-weight version)
 - Horizontal, single-stage or multi-stage
 - Base plate version (pump and motor on shared base plate)
- SOHB...W
 - as SOH...W
 - Block version with flange-mounted motor
- SFH...WW
 - Self-priming side channel pump PN 25, capable of handling aerated fluids (medium-weight version)
 - Horizontal, single-stage and multi-stage
 - Base plate version (pump and motor on shared base plate)
- SOR...W
 - Self-priming side channel pump PN 6, capable of handling aerated fluids
 - Horizontal, single-stage
 - Short design as nozzles are arranged side-by-side, radially upwards
- SVG
 - Self-priming inline side channel pump PN 16, capable of handling aerated fluids
 - Vertical, single-stage
 - Block version with flange-mounted motor
- SRZ...WW
 - Self-priming side channel pump PN 40, capable of handling aerated fluids (heavy version)
 - Horizontal, single-stage and multi-stage
 - Base plate version (pump and motor on shared base plate)
- SRZS...W
 - Multifunction pump – pump combining a side channel pump and a centrifugal pump
 - Side channel pump PN 40, capable of handling aerated fluids (heavy version)
 - Horizontal, single-stage and multi-stage
 - With upstream suction impeller and axial suction branch to achieve lower NPSH values
 - Base plate version (pump and motor on shared base plate)

- SHP
 - Self-priming, gas handling side channel pump PN 100 (high-pressure design)
 - Horizontal, single-stage and multi-stage
 - In single or double jacket housing
 - With upstream suction impeller and axial suction branch to achieve lower NPSH values
 - Base plate version (pump and motor on shared base plate)
- SOHM
 - Self-priming side channel pump PN 16, capable of handling aerated fluids (light-weight version)
 - Horizontal, single-stage or multi-stage
 - Magnetic coupling
 - Block version with flange-mounted motor
- SVM
 - As SVG
 - Magnetic coupling
- SEMA-L/Z (SEMA-L-Block)
 - As SRZ...WW
 - Magnetic coupling
 - SEMA-L: Base plate version (pump and motor coupled flexibly on shared base plate)
 - SEMA-L-Block: Pump and motor on shared base plate, motor flange-mounted to pump directly
- SEMA-S (SEMA-S-Block)
 - As SRZS...W
 - Magnetic coupling
 - SEMA-S: Base plate version (pump and motor coupled flexibly on shared base plate)
 - SEMA-S-Block: Pump and motor on shared base plate, motor flange-mounted to pump directly

3.1.3 Other signs at the pump

Picture	Explanation
	Sense of rotation arrow
	Sense of rotation arrow (variant)
	Suction and pressure connection
	Strong magnet, magnetic coupling
	Auxiliary medium at entrance
	Auxiliary medium at exit

Tab. 6 Signs at the pump

3.1.4 ATEX plate

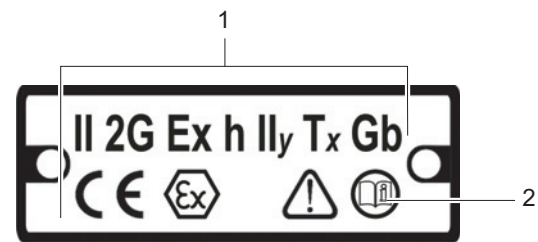


Fig. 2 ATEX plate (example)

- 1 Explosion protection mark
- 2 Reference to ATEX additional instructions (→ 9.5 ATEX additional instructions, Page 46).

3.2 Layout

Self-priming side channel pump

The side channel pump is suitable for pumping pure and cloudy fluids, as well as those containing gas. The narrow gap clearance means that the pump is not suitable for pumping media with abrasive or aggressive admixtures or solid content.

The pump characteristics of the side channel pump differ greatly from those of a centrifugal pump. As the pressure increases, the motor power required also **increases**.

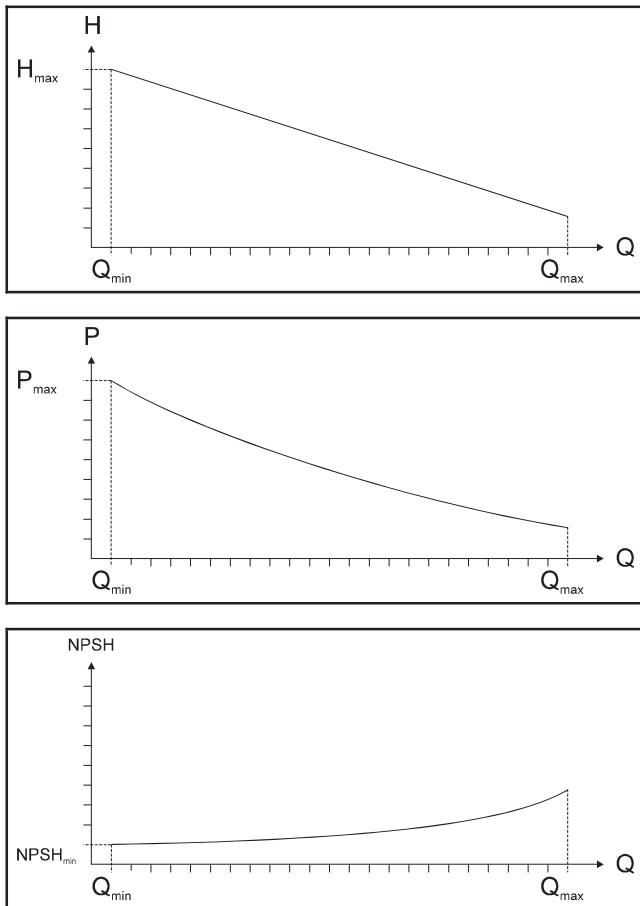


Fig. 3 Side channel pump characteristics

The following conditions must be observed when operating a side channel pump:

- Start it up only when the pressure-side gate valve is fully open
- Never close the pressure-side gate valve fully
- Observe the flow rate limits (Q_{min} , Q_{max})

The side channel pump can transport air or gases and evacuate a suction pipe. The suction capacity is limited to a vacuum suction head of 7 m (at a water temperature of 20 °C). The suction capacity is reduced for pumped liquids at higher temperatures, with a higher specific weight or at lower evaporation pressures. Pump type SHP is not self-priming.

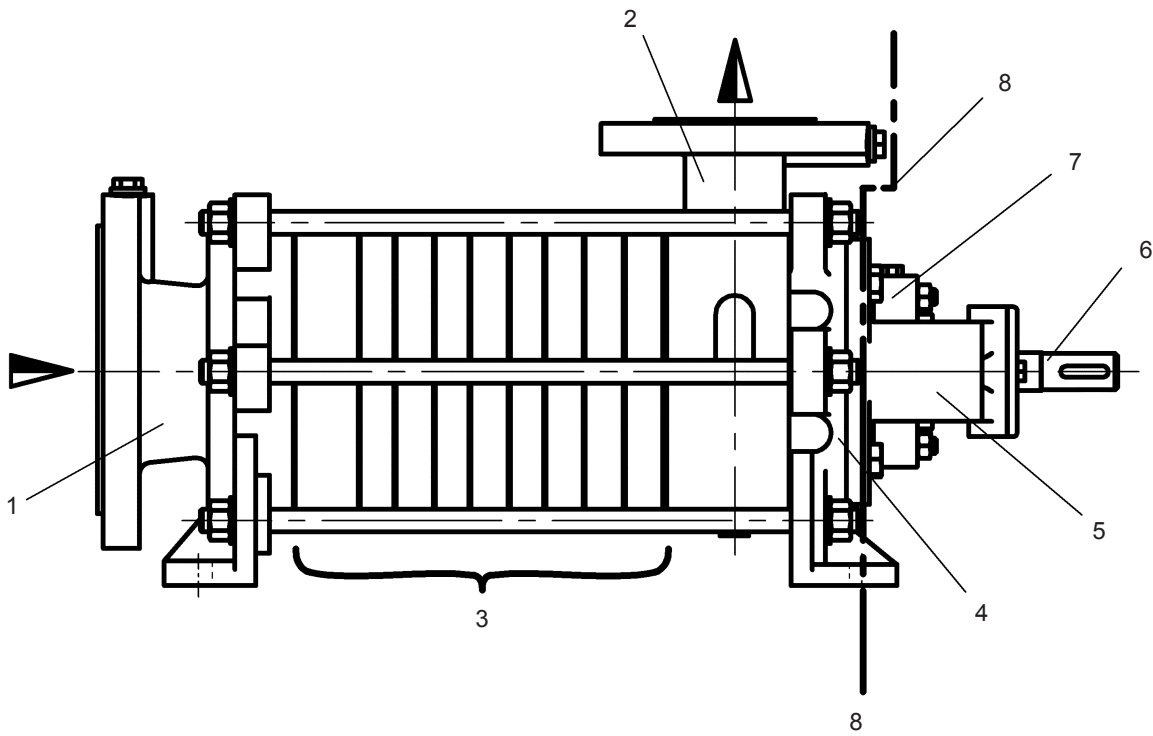


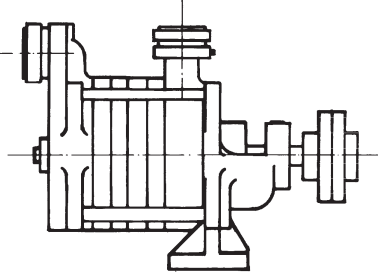
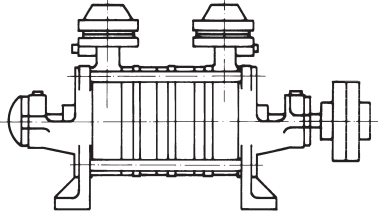
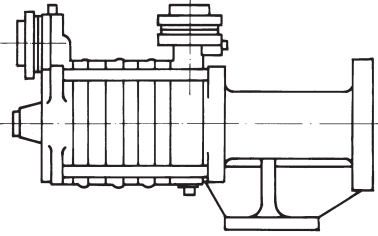
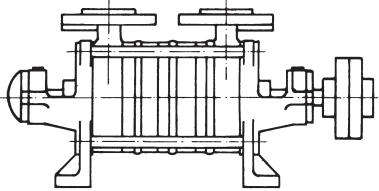
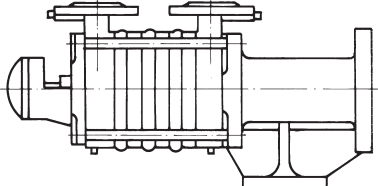
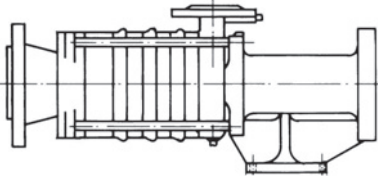
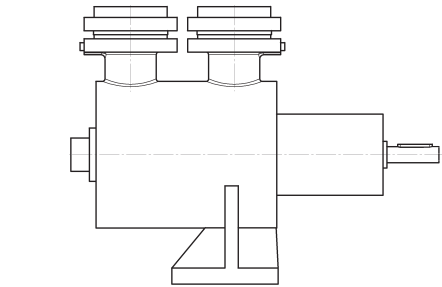
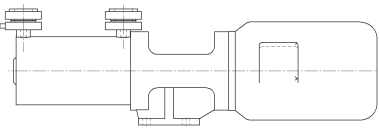
Fig. 4 Construction (example)

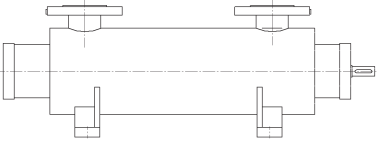
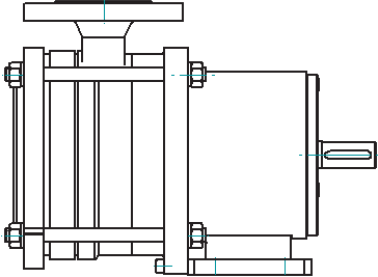
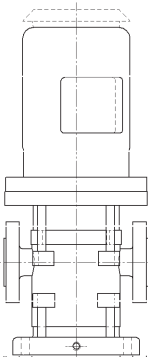
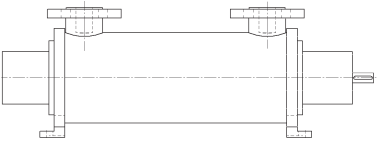
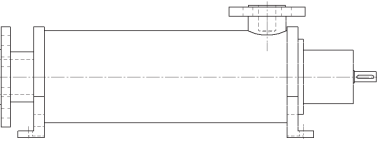
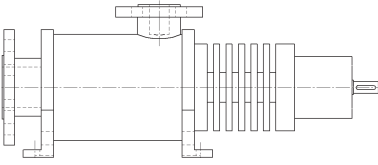
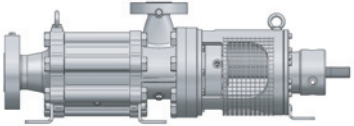
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|-----------------------------|-------------------|-----------------------------|
| 1 Housing (suction casing) | 4 Foot | 7 Shaft seal housing |
| 2 Housing (pressure casing) | 5 Bearing bracket | 8 Limit for heat insulation |
| 3 Hydraulics | 6 Shaft | |

3.3 Variants

- Horizontal or vertical operation
- Free shaft (without a motor or a base plate)
- Final unit (mounted on base plate, with drive motor, coupling and contact guard)
- With mechanical seal or magnetic coupling

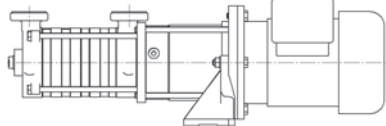
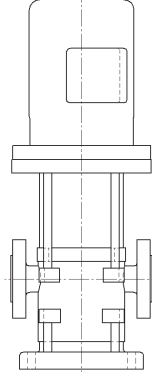
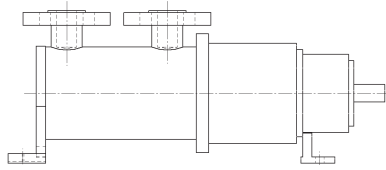
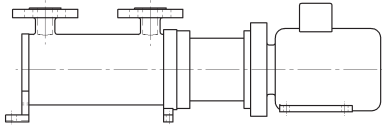
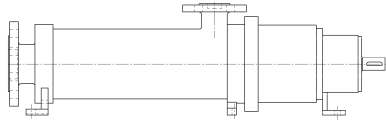
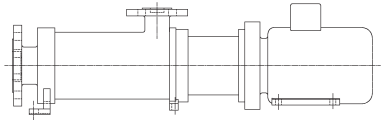
3.3.1 Variants with a mechanical seal

SON...W		SON...WW	
SOB...W		SRN...WW	
SRB...WW		SRBS...W	
SOH...W		SOHB...W	

SFH...WW		SOR...W	
SVG		SRZ...WW	
SRZS...W		SRZS...W KK	
SHP			


Tab. 7 Variants with a mechanical seal

3.3.2 Variants with a magnetic coupling


SOHM		SVM	
SEMA-L SEMA-Z		SEMA-L-Block SEMA-Z-Block	
SEMA-S		SEMA-S-Block	

Tab. 8 Variants with a magnetic coupling


3.4 Shaft seals

 Only one of the following shaft seals can be used.

3.4.1 Stuffing box packings


 Stuffing box packings have functional drop leaks.

3.4.2 Mechanical seals

 Mechanical seals have functional drop leaks.

- Single-action mechanical seal
- Double-action mechanical seal

3.4.3 Magnetic coupling

 Magnetic couplings are hermetically sealed.

3.5 Auxiliary operating systems

3.5.1 Sealing systems

Quenching

The pressure of the pumped medium is higher than the pressure of the sealing medium during quenching. Pumped medium penetrates the sealing medium.

Application example: Pumped liquids that can crystallize in the atmosphere and thus cause damage to the seal in the long-term

Blocking

The pressure of the sealing medium is higher than the pressure of the pumped liquid when blocking. The seal surfaces are lubricated by the sealing medium.


Application example: Pumped liquids that can crystallize and thus cause damage to the seal in the long-term

3.6 Bearings and lubrication

- Series SON...W
 - Drive side: single-row groove ball bearing lubricated with grease
 - Outlet flange and intermediate levels: sleeve bearings lubricated by pumped liquid
- Series SON...WW
 - On both sides: single-row groove ball bearings lubricated with grease
 - Intermediate levels: sleeve bearings lubricated by pumped liquid
- Series SOB...W
 - Drive side: single-row groove ball bearing lubricated with grease
 - Outlet flange and intermediate levels: sleeve bearings lubricated by pumped liquid
- Series SRN...WW
 - On both sides: single-row groove ball bearings lubricated with grease
 - Intermediate levels: sleeve bearings lubricated by pumped liquid
- Series SRB...WW
 - On both sides: single-row groove ball bearings lubricated with grease
 - Intermediate levels: sleeve bearings lubricated by pumped liquid
- Series SRBS...W
 - Drive side: single-row groove ball bearing lubricated with grease
 - Suction side: special carbon sleeve bearing
 - Intermediate levels: sleeve bearings lubricated by pumped liquid
- Series SOH...W, SOHB...W
 - Drive side: single-row groove ball bearing lubricated with grease
 - Outlet flange and intermediate levels: sleeve bearings lubricated by pumped liquid
- Series SFH...WW
 - On both sides: single-row groove ball bearings lubricated with grease
 - Intermediate levels: sleeve bearings lubricated by pumped liquid
- Series SOR
 - Externally: two single-row groove ball bearings lubricated with grease
- Series SVG
 - Drive side: rigid sleeve coupling connected to motor shaft
 - Base: special carbon bearing bush lubricated by pumped liquid
- Series SRZ...WW
 - On both sides: single-row groove ball bearings lubricated with grease
 - Intermediate levels: sleeve bearings lubricated by pumped liquid
- Series SRZS...W
 - Drive side: single-row groove ball bearing lubricated with grease
 - Suction side: special carbon sleeve bearing
 - Intermediate levels: sleeve bearings lubricated by pumped liquid
- Series SHP
 - Drive side: grease-lubricated or oil-lubricated, single-row angular contact ball bearings (number: 2 to 4 depending on the configuration)
 - Suction side: special carbon sleeve bearing
 - Intermediate levels: sleeve bearings lubricated by pumped liquid
- Series SOHM
 - Internally: Radial sleeve bearing
 - Intermediate levels: sleeve bearings lubricated by pumped liquid
- Series SVM
 - Below the magnetic coupling: combined axial and radial sleeve bearing
 - Base: special carbon bearing bush lubricated by pumped liquid
- Series SEMA (all variants)
 - Externally: two single-row groove ball bearings lubricated with grease
 - Internally: combined axial and radial sleeve bearing
 - Stage casing and intermediate level: sleeve bearings lubricated by pumped liquid

4 Transport, storage and disposal

4.1 Transport

 Weight specifications (→ delivery note)

DANGER

Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

4.1.1 Unpacking and inspection on delivery

1. After receiving the delivery, check that it is complete.
2. Unpack the pump/unit on delivery and inspect it for transport damage.
3. Report any transport damage to the delivery company immediately.
4. Dispose of packaging material according to local regulations.

4.1.2 Lifting

DANGER

Death or crushing of limbs caused by falling loads!

- ▶ Use lifting gear appropriate for the total weight to be transported.
- ▶ Fasten the lifting gear as shown in the following illustrations.
- ▶ Do not stand under suspended loads.

- ▶ Lift the pump/unit properly (see figs).

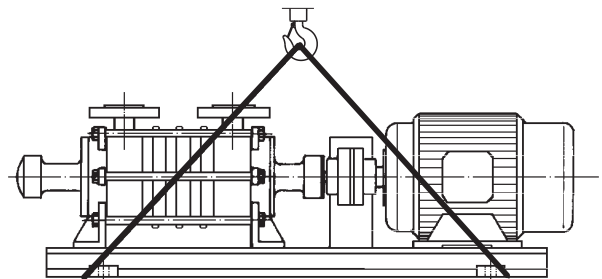


Fig. 5 Fastening the lifting gear to the pump unit with base plate

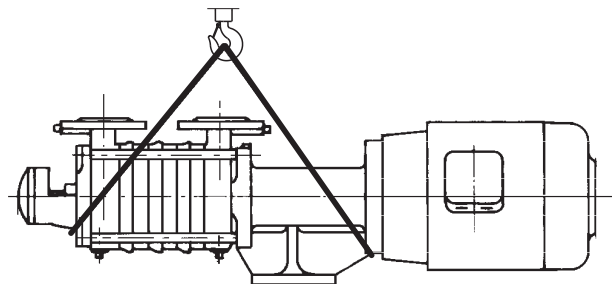


Fig. 6 Fastening the lifting gear to the block pump (horizontal variant)

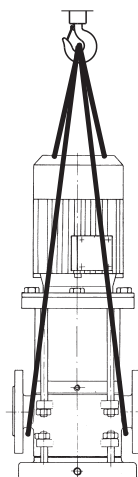



Fig. 7 Fastening the lifting gear to the block pump (vertical variant)

4.2 Treatment for storage

 Pumps made of gray cast iron or spheroidal iron are treated at the plant (→ trailer at the pump).

NOTE

Material damage due to missing or inappropriate treatment for storage!

- ▶ Treat the pump properly, inside and outside, for storage.

4.2.1 Applying preservative to the inside

1. Close the suction-side flange with a blank flange.
2. With opposite flanges, turn the pump on the suction flange.
3. Fill pump with suitable preservative
4. Turn the shaft slowly in the pump's sense of rotation.
5. Continue filling and turning until preservative escapes from the pressure flange without bubbles.
6. Close the pressure-side flange with a blank flange.

4.2.2 Applying preservative to the outside

- ▶ Apply preservative to all bare metal parts.

4.3 Storage

 **DANGER**

Risk of death and material damage due to magnetic field!


- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

NOTE

Material damage due to inappropriate storage!

- ▶ Treat and store the pump properly.
1. Seal all openings with blank flanges, blind plugs or plastic covers.
 2. Make sure the storage room meets the following conditions:
 - Dry
 - Frost-free
 - Vibration-free
 3. Turn the shaft once every two months.
 4. Every 6 months:
 - Renew the preservative if necessary.

4.4 Removing the preservative

 Only needed if used in a relevant sector (e.g. food sector) and if the pump has been treated.

WARNING

Risk of poisoning from preservatives and cleaning agents in the foodstuffs and drinking water sector!

- ▶ Only use cleaning agents which are compatible with the pumped liquid.
- ▶ Completely remove all preservative.

NOTE

High water pressure or spray water can damage bearings!

- ▶ Do not clean bearing areas with a water or steam jet.

NOTE

Damage to seals due to wrong cleaning agents!

- ▶ Ensure the cleaning agent does not corrode the seals.
1. Choose the cleaning agent according to the application.
 2. Dispose of preservatives according to local regulations.
 3. For storage times in excess of 6 months:
 - Replace the elastomer parts made of EP rubber (EPDM).
 - Check all elastomer parts (O-rings, shaft seals) for proper elasticity and replace them if necessary.

4.5 Disposal

DANGER

Risk of death and material damage due to magnetic field!


- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

WARNING

Risk of poisoning and environmental damage by the pumped liquid!

- ▶ Use personal protective equipment when carrying out any work on the pump.
- ▶ Prior to the disposal of the pump:
 - Collect and dispose of any leaking pumped liquid in accordance with local regulations.
 - Neutralize residues of pumped liquid in the pump.
 - Remove the preservative (→ 4.4 Removing the preservative, Page 19).
- ▶ Dispose of the pump in accordance with local regulations.

5 Setup and connection

 For pumps in explosion-hazard areas (→ 9.5 ATEX additional instructions, Page 46).

Short instructions for trained specialist personnel (→ 9.4 Short instructions for commissioning a pump unit delivered complete, Page 45).

NOTE

Material damage due to distortion or passage of electrical current in the bearing!

- ▶ Do not make any structural modifications to the pump unit or pump casing.
- ▶ Do not carry out any welding work on the pump unit or pump casing.

NOTE

Material damage caused by dirt!

- ▶ Do not remove any covers or transport and sealing covers until immediately before connecting the pipes to the pump.

5.1 Preparing the setup

DANGER

Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

5.1.1 Checking the ambient conditions

1. Make sure the required ambient conditions are fulfilled (→ 9.1.1 Ambient conditions, Page 41).
2. For setup altitude > 1000 m above sea level, consult the manufacturer.

5.1.2 Plan operation of pump with changing speed

NOTE

Material damage caused by deviating operating parameters!

- ▶ Only use pump with a shaft speed of 900 rpm to 1,800 rpm (SHP series up to 3,600 rpm).
- ▶ Make sure that the motor is not overloaded when the speed is increased.
- ▶ Make sure that the max. permissible pressure for housing and sealing system is not exceeded.
- ▶ Make sure that the permissible values of the flow rate (Q), the delivery head (H) and the shaft output (P) do not go below or above the minimum and maximum values, respectively, when the speed is changed.

1. Operating the pump under with changing speeds should be agreed with the manufacturer.
2. If necessary, request modified pump performance curve from manufacturer.

5.1.3 Preparing the installation site

- ▶ Ensure the installation site meets the following conditions:
 - Pump is freely accessible from all sides
 - Sufficient space for the installation/removal of the pipes and for maintenance and repair work, especially for the removal and installation of the pump and the motor
 - Pump not exposed to external vibrations (damage to bearings)
 - Frost protection

5.1.4 Preparing the foundation and surface

 Setup options:


- With concrete foundation
- With steel foundation frame

- ▶ Make sure the foundation and surface meet the following conditions:
 - Level
 - Clean (no oil, dust or other impurities)
 - Capable of bearing the weight of the pump unit and all operating forces
 - The pump is stable and cannot tip over
 - With concrete foundation: standard concrete of strength class B 25

5.1.5 Removing the preservative

- ▶ If the pump is to be put into operation immediately after setup and connection: Remove the preservative prior to setup (→ 4.4 Removing the preservative, Page 19).

5.1.6 Installing the heat insulation

 Only necessary to maintain the temperature of the pumped liquid.

NOTE

Material damage on the bearing or shaft seal due to overheating!

► Only install the heat insulation on the pump casing (→ 3.2 Layout, Page 11).

► Install the heat insulation properly.

5.2 Planning the pipes

5.2.1 Specifying supports and flange connections


NOTE

Material damage due to excessive forces and torques exerted by the piping on the pump!

► Do not exceed permissible values (these can be requested from the manufacturer if required).

1. Calculate the pipe forces, taking every possible operating condition into account:
 - Cold/warm
 - Empty/full
 - Depressurized/pressurized
 - Positional changes of the flanges
2. Ensure the pipe supports have permanent low-friction properties and do not seize up due to corrosion.

5.2.2 Specifying nominal diameters

 Keep the flow resistance in the pipes as low as possible.
Flow rate in suction pipe < 1 m/s

1. Make sure the nominal suction pipe diameter is \geq the nominal suction branch diameter.
2. Make sure the nominal pressure pipe diameter is \geq the nominal outlet flange diameter.

5.2.3 Specifying pipe lengths

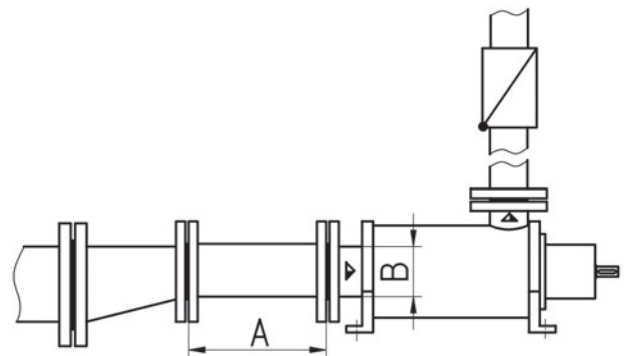



Fig. 8 Straight pipe lengths upstream and downstream of the pump (recommended)

A > 10 x nominal suction pipe diameter

B Nominal suction pipe diameter

► Maintain the recommended minimum values when installing the pump.

 Suction side: Shorter pipes are possible but may restrict the hydraulic performance.

5.2.4 Determining the suction pipe

1. Suction operation:
 - Place the suction strainer at least 0.2 m below the lowest fluid level.
 - Install a foot valve.
2. Supply operation:
 - Fluid level min. 0.5 above the center of the suction flange
 - Install a compensating line in the case of a supply container with vacuum pressure.

5.2.5 Optimizing changes in cross-section and direction

1. Avoid bending radii of less than 1.5 times the nominal pipe diameter.
2. Avoid abrupt changes of cross-section along the piping.

5.2.6 Optimizing supply ratios

- Ensure that $NPSH_{system} > NPSH_{pump}$ (→ data sheet/performance curve):
- in the case of the worst $NPSH_{system}$
 - at minimum pumping pressure

5.2.7 Providing safety and control devices (recommended)

Avoid impurities

1. Install a filter in the suction pipe, (mesh size of 0.1 mm.).
2. To monitor impurities, install a differential pressure gauge with a contact manometer.

Avoiding reverse running

- ▶ Install a slow-closing non-return member between the outlet flange and the gate valve to ensure that the pumped liquid does not flow back when the pump is switched off.

Avoiding excessive pressure

1. Provide appropriate pressure relief valves or other safety device in the pressure line.
2. Do **not** feed the return flow of the pressure relief valve directly back into the suction pipe.

Making provisions for isolating and shutting off pipes



For maintenance and repair work.

1. Provide shut-off devices in the suction and pressure pipes.
2. Recommended: Provide a means of emptying.

Allowing measurement of the operating conditions

WARNING

Material damage due to impermissible operating point!

- ▶ Include speed, pressure and temperature monitoring devices to ensure that the operating limits are observed.
1. Provide manometers for pressure measurements in the suction and pressure pipes.
 2. Provide load monitors (minimum and maximum load) on the motor side.
 3. Provide for pump-side temperature measurements.
 4. Provide a fill level indicator for the pump.

5.2.8 Installation recommendations

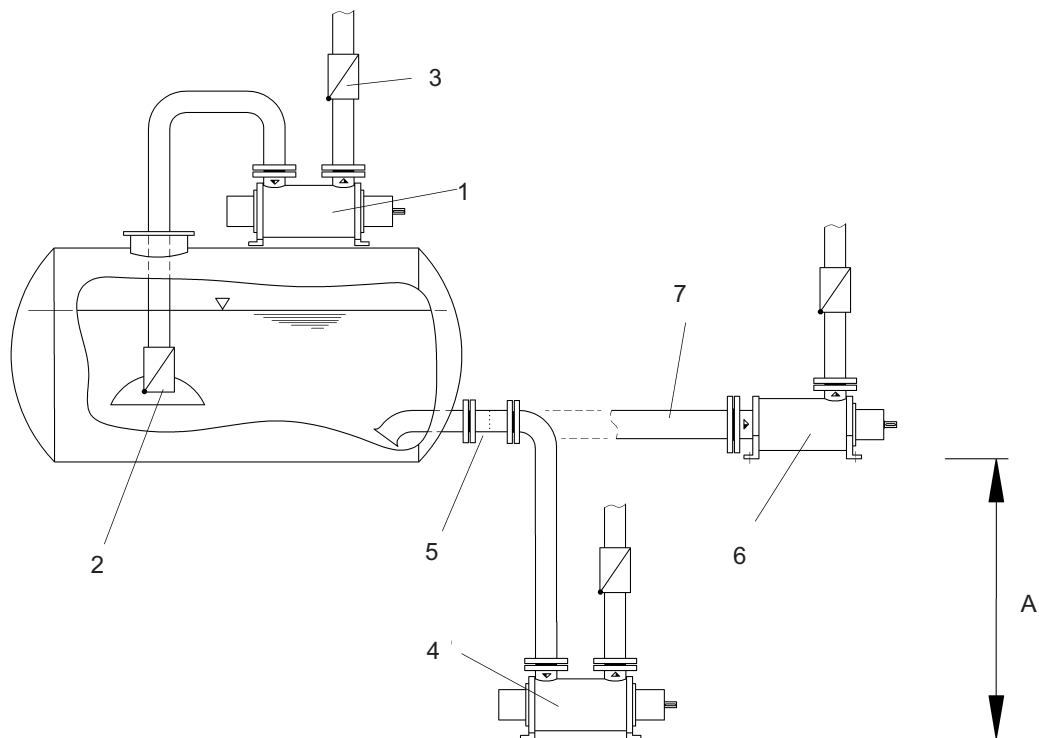


Fig. 9 Installation example

- A Head difference (with/without suction impeller)
- 1 Pump in suction operation
- 2 Suction strainer and non-return valve (foot valve)
- 3 Backflow preventer
- 4 Pump (without suction impeller) in supply operation
- 5 Filter/strainer
- 6 Pump (with suction impeller) in supply operation
- 7 Settling section

5.3 Installation on a foundation



Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

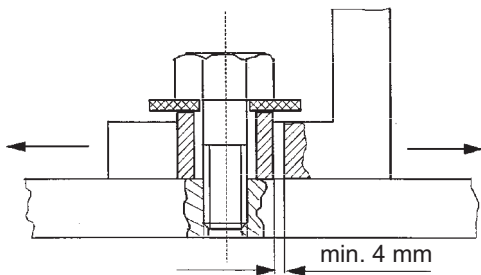
NOTE

Material damage due to distortion of the base plate!

- ▶ Place the base plate on the foundation and fasten it as described below.

5.3.1 Preparing the pump unit

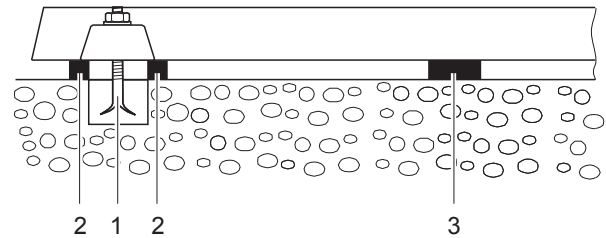
1. At pumped liquid temperatures of $-20\text{ °C} < T < 120\text{ °C}$:
 - Tighten the fastening screws of the pump feet on the drive end and non-drive end.



2. At pumped liquid temperatures of $T > 120\text{ °C}$ or $T < -20\text{ °C}$, the pump body must be able to expand and contract without obstruction:
 - Tighten the fastening screws of the pump feet on the drive end.
 - Mount pump feet on the non-drive end on the base plate using screws and support sleeves only.
 - Avoid all pipe forces and torques on the pump flange on the non-drive end which might raise the pump.

5.3.2 Setting the pump unit on the foundation

- ✓ Aids, tools and materials:
 - Foundation bolts (not contained in the scope of delivery)
 - Steel washers
 - Non-shrinking mortar grout
 - Spirit level



1. Lift the pump unit (→ 4.1 Transport, Page 17).
 2. Attach the foundation bolts from below into the base plate fixing holes.
- Observe the manufacturer's instructions when using adhesive anchors.
3. Set the pump unit down on the foundation. When doing so, sink the foundation bolts into the prepared anchoring holes.
 4. Use steel washers to align the pump unit to the height and system dimensions as described below:
 - Place a steel washer (2) to the left and right-hand side of each foundation bolt (1).
 - If the distance between the anchoring holes is greater than 750 mm, place additional steel washers (3) in the middle, on each side of the base plate.
 5. Make sure the steel washers lie flat against the base plate, in full contact.
 6. Use the integrated spirit level to check the maximum allowable tilt of 1 mm/m (end-to-end and side-to-side).
 7. Repeat the procedure until the base plate is correctly aligned.

5.3.3 Fastening the pump unit

- Not necessary for block versions of pumps.
- The damping behavior is improved by filling the base plate with mortar grout.

1. Fill the anchoring holes with mortar grout.
2. When the mortar grout has set, screw down the base plate at three points with the specified torque.
3. Before tightening the remaining bolts, compensate for any unevenness in the surface using metal spacing shims next to each bolt.
4. Fill the inside of the base plate with concrete, if intended. Knock on the base plate to ensure that no cavities are created in the process.
5. Make sure the base plate is not distorted.

5.4 Connecting the pipes

DANGER

Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.


5.4.1 Keeping the pipes clean

NOTE

Material damage due to impurities in the pump!


- ▶ Make sure no impurities can enter the pump.
1. Clean all pipe parts and fittings prior to assembly.
 2. Ensure no flange seals protrude inwards.
 3. Remove any blank flanges, plugs, protective foils and/or protective paint from the flanges.

5.4.2 Installing auxiliary piping

-  Observe the manufacturers' specifications for any auxiliary operating systems which are present.


1. Connect the auxiliary pipes to the auxiliary connections so that they are stress-free and do not leak.
2. To avoid air pockets: Run the pipes with a continuous slope up to the pump.

5.4.3 Installing the suction pipe

-  Observe the arrow indicating the flow of direction.
If necessary, integrate a filter into the suction line to prevent impurities.

1. Remove the transport and sealing covers from the pump.
2. To avoid air pockets: Run the pipes with a continuous slope up to the pump.
3. Ensure no seals protrude inwards.
4. For suction operation: install a foot valve in the suction pipe to prevent the pump and suction pipe from running empty during downtimes.

5.4.4 Installing the pressure pipe

-  Observe the arrow indicating the flow of direction.

1. Remove the transport and sealing covers from the pump.
2. Run the pressure pipe with a continuous downward slope to the pump.
3. Ensure no seals protrude inwards.

5.4.5 Checking the stress-free pipe connections

- ✓ Piping installed and cooled down


NOTE

Material damage due to distorted pump casing!

- ▶ Ensure that all pipes are stress relieved when connected to the pump.

1. Disconnect the pipe connecting flanges from the pump.
2. Check whether the pipes can be moved freely in all directions within the expected range of expansion.
3. Make sure the flange surfaces are parallel.
4. Reconnect the pipe connecting flanges to the pump.

5.5 Installing the motor

-  Only necessary if the pump unit is assembled on site.


NOTE

Material damage caused by knocks and bumps!

- ▶ Keep the coupling halves properly aligned when slipping them on.
- ▶ Do not knock or hit any components of the pump.

1. Insert the shaft keys.
2. Slide on the pump-side and motor-side coupling halves until the shaft end is flush with the coupling hub. In doing so, maintain a clearance of 2–4 mm between the coupling halves.
3. Tighten the grub screws on both coupling halves.
4. Use suitable metal shims on the motor to align the end of the motor shaft to the end of the pump shaft.
5. Screw in the motor bolts, but do not tighten them yet (→ 5.7 Aligning the motor, Page 27).
6. Install the safety guarding.

5.6 Aligning the coupling precisely

 Only for horizontal versions.

⚠ DANGER

Risk of death due to rotating parts!

- ▶ Isolate the motor from its supply voltage and keep it locked when carrying out any fitting or maintenance work.

NOTE

Material damage due to incorrect alignment of the coupling!

- ▶ Align the motor exactly to the pump if there is any vertical, lateral or angular misalignment.
- ▶ For detailed information and special couplings (→ manufacturer's specifications).

NOTE

Material damage due to incorrect dimensions when setting the coupling!

Other adjustment dimensions/offsets apply to couplings not named in table 9.

- ▶ Ask manufacturer for adjustment dimensions/offsets.

Checking the alignment of the coupling

- ✓ Aids, tools and materials:
 - Feeler gauge
 - Straightedge
 - Dial gauge (for couplings with spacer piece)
 - Other suitable tools, e.g. laser alignment instrument

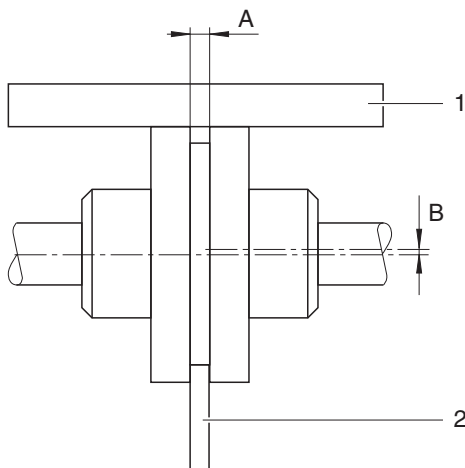


Fig. 10 Checking the alignment of the coupling

1. Measure in two planes at an angle of 90° on the circumference of the coupling.

2. Check the light gap towards the outer diameter using a straightedge (1):
 - Position the straightedge across both halves of the coupling.
 - Align the motor if there is a visible gap on the outer diameter (→ 5.7 Aligning the motor, Page 27).
3. Measure gap A with a feeler gauge (2):

Size	Gap A [mm]	Lateral/vertical misalignment B [mm]	Angular displacement ¹⁾ [mm]
1 (58)	2 ... 4	0.15	0.15
2 (68)	2 ... 4	0.15	0.15
3 (80)	2 ... 4	0.15	0.15
4 (95)	2 ... 4	0.20	0.20
5 (110)	2 ... 4	0.20	0.20
6 (125)	2 ... 4	0.20	0.20
7 (140)	2 ... 4	0.20	0.20
8 (160)	2 ... 6	0.25	0.25

Tab. 9 Coupling setting

- 1) $Gap_{max} - Gap_{min}$
 - Use the feeler gauge to measure the gap (A) between the coupling halves.
 - Align the motor if the gap is too wide (→ 5.7 Aligning the motor, Page 27).

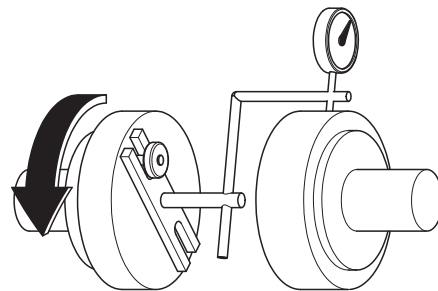


Fig. 11 Checking for lateral and vertical misalignment

4. Check lateral or vertical misalignment B using the dial gauge:
 - Carry out the measurement as illustrated.
 - Align the motor if there is any lateral or vertical misalignment (→ 5.7 Aligning the motor, Page 27). Permissible axial or radial deviation, measured on the coupling front or circumference: < 0.05 mm

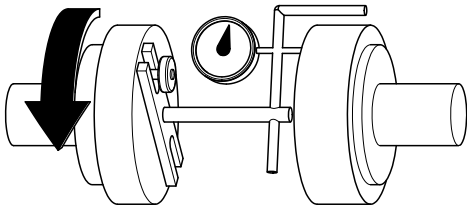



Fig. 12 Checking for angular displacement

5. Check the angular displacement with a dial gauge:
 - Permissible angular displacement (→ Tab. 9 Coupling setting, Page 26).
 - Carry out the measurement as illustrated.
 - If there is any angular displacement: align the motor (→ 5.7 Aligning the motor, Page 27).
6. Install the safety guarding properly.

5.7 Aligning the motor

-  Only for horizontal versions. Alignment options:
- With sets of shims
 - With adjusting screws

5.7.1 Aligning the motor with sets of shims

1. Align the motor so that the coupling halves are exactly in line and fit shims if necessary.
2. Check the alignment.
3. Repeat the alignment procedure if there is still any vertical misalignment.
4. Then tighten the motor bolts.

5.8 Electrical connection

DANGER

Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

DANGER

Risk of death due to electric shock!


- ▶ Have all electrical work carried out by qualified electricians only.

DANGER

Risk of death due to rotating parts!


- ▶ Isolate the motor from its supply voltage and keep it locked when carrying out any fitting or maintenance work.
- ▶ Reinstall the safety guarding after all fitting and maintenance work.

5.8.1 Connecting the motor

-  Follow the instructions of the motor manufacturer.

1. Connect the motor according to the connection diagram.
2. Make sure no danger arises due to electric power.
3. Install an EMERGENCY STOP switch.

6 Operation

 For pumps in explosion-hazard areas (→ 9.5 ATEX additional instructions, Page 46).

Short instructions for trained specialist personnel (→ 9.4 Short instructions for commissioning a pump unit delivered complete, Page 45).

6.1 Putting the pump into service for the first time

DANGER

Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

6.1.1 Performing the pressure test

NOTE


Material damage due to excessive pressure!

- ▶ Ensure that the test pressure does not exceed 1.3 times the nominal pressure of the pump (→ data sheet/performance curve).
- ▶ Ensure that the test pressure does not exceed 1.3 times the nominal pressure of the sealing system (→ data sheet/performance curve).
- ▶ If the test pressure is higher, remove the pump from the pressure test.


- ▶ Carry out the pressure test properly.

6.1.2 Identifying the pump type

- ▶ Identify the pump type (→ data sheet/performance curve).


 The pump types vary e.g. with regard to the shaft seal or auxiliary systems.

6.1.3 Removing the preservative

 Only necessary for pumps treated for storage.

- ▶ (→ 4.4 Removing the preservative, Page 19).

6.1.4 Preparing auxiliary systems (if available)

 The manufacturer does not accept any liability for damage caused by installing or using a third-party or unapproved auxiliary system.

Sealing systems

1. Ensure that the sealing medium is suitable for mixing with the pumped liquid.
2. Install the sealing system (→ manufacturer's specifications).
3. Make sure the parameters required for the installed sealing system are met (→ manufacturer's specifications).

6.1.5 Filling and bleeding

- ✓ Auxiliary operating systems ready for operation

WARNING

Risk of injury and poisoning due to hazardous pumped liquids!

- ▶ Safely collect any leaking pumped liquid and dispose of it in accordance with environmental rules and requirements.

NOTE

Material damage caused by dry running!

- ▶ Make sure the pump is filled properly.
1. Fill the pump and the suction pipe with pumped liquid.
 - If pumped media are hot ($T > 100\text{ °C}$), ensure that the change in temperature of the pump housing is $< 10\text{ K/min}$.
 2. Open the suction-side fitting.
 3. Open the pressure-side fitting.
 4. If present: open the auxiliary systems and check the flow rate.
 5. Ensure that no pipe connections are leaking.

6.1.6 Checking the sense of rotation

- ✓ Pump filled and bled

DANGER

Risk of death due to rotating parts!

- ▶ Use personal protective equipment when carrying out any work on the pump.
- ▶ Keep an adequate distance to rotating parts.

NOTE

Material damage caused by dry running!

- ▶ Make sure the pump is filled properly.
1. Switch the motor on and immediately off again.
 2. Check whether the motor's sense of rotation is the same as that of the arrow on the pump.
 3. If the sense of rotation is different: Swap two phases (→ 5.8.1 Connecting the motor, Page 27).

6.2 Start-up

DANGER

Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

6.2.1 Switching on

- ✓ Pump set up and connected properly
- ✓ Motor set up and connected properly
- ✓ Motor exactly aligned with the pump
- ✓ All connections stress-free and sealed
- ✓ Any available auxiliary systems are ready for operation
- ✓ All safety equipment installed and tested for functionality
- ✓ Pump prepared, filled and bled properly
- ✓ Pump at rest (not running in reverse)

DANGER

Risk of injury due to running pump!

- ▶ Do not touch the running pump.
- ▶ Do not carry out any work on the running pump.
- ▶ Allow the pump to cool down completely before starting any work.

DANGER

Risk of injury and poisoning due to pumped liquid spraying out!

- ▶ Use personal protective equipment when carrying out any work on the pump.

NOTE

Material damage caused by dry running!

- ▶ Make sure the pump is filled properly.

NOTE

Risk of cavitation when throttling down the suction flow rate!

- ▶ Fully open the suction-side fitting and do not use it to adjust the flow rate.
- ▶ Do not open the pressure-side fitting beyond the operating point.


NOTE

Material damage caused by overheating!

- ▶ Do not operate the pump while the pressure-side fitting is closed.
- ▶ Observe the minimum flow rate (→ data sheet/performance curve).

1. Open the suction-side fitting.
2. Open the pressure-side fitting.
3. Bypass line (if present):
 - Close it in suction operation during suction phase.
 - Open it during supply operation.
4. With self-priming pumps (SHP), ensure intake.
5. Switch on the motor and make sure it is running smoothly.
6. Limit suction by the pump to a maximum of one minute.
7. Once the motor has reached its nominal speed, close the pressure-side fitting slowly until the operating point is reached (→ data sheet/performance curve).
8. Make sure any temperature changes at pumps with hot pumped liquids are below 10 K/min.
9. After the first load under pressure and at operating temperature, check that the pump is not leaking.
10. If the pumped liquid is hot or very cold, switch off the pump briefly at operating temperature, check the alignment of the coupling and realign the motor if necessary (→ 5.6 Aligning the coupling precisely, Page 26).
11. Switch the pump on and off a maximum of 10 times per hour.

6.2.2 Changing the operating parameters

 When using the pump in boiler feed systems, note the following:

If the feed boiler is being operated temporarily with a lower operating pressure, the pump must be throttled down to the boiler's normal design operating pressure at the pressure side using a manual gate valve and a manometer attached at the outlet flange of the pump casing.

NOTE

Material damage caused by deviating operating parameters!

- ▶ Increasing the flow rate can cause cavitation.
- ▶ Pumped liquids with higher density require higher motor output and may overload the motor.

1. If the flow rate is increased, ensure that $NPSH_{system} > NPSH_{required}$ is observed.
2. If the density of the pumped liquid is increased, please ensure that the drive motor is not overloaded.

6.2.3 Switching off (temporarily)

 **WARNING**

Risk of injury due to hot pump parts!

- ▶ Use personal protective equipment when carrying out any work on the pump.

1. If the pump remains under pressure while at rest: leave any auxiliary operating systems running.
2. Leave the bypass line open.
3. Switch off the motor.
4. Close the suction-side and pressure-side fittings when the motor has come to a standstill.
5. After initial start-up: Check all tie bolts and tighten them if necessary.

6.3 Shutting down the pump

⚠ DANGER

Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

⚠ WARNING

Risk of injury and poisoning due to hazardous pumped liquids!

- ▶ Safely collect any leaking pumped liquid and dispose of it in accordance with environmental rules and requirements.
1. During supply operation, close the suction-side fitting.
 2. Auxiliary operating systems
 - If the pump remains under pressure: leave it running
 - If fluid is being supplied from vacuum systems: leave it running
 - If running in parallel with a shared suction pipe: leave it running
 - Otherwise: shut it off

3. Take the following measures whenever the pump is shut down:

Pump is	Measure
...shut down for a prolonged period	▶ Take measures according to the pumped liquid (→ Tab. 11 Measures depending on the behavior of the pumped liquid, Page 31).
...emptied	▶ Close the suction-side and pressure-side fittings.
...dismounted	▶ Isolate the motor from its power supply and secure it against unauthorized switch-on.
...put into storage	▶ Follow the storage instructions (→ 4.3 Storage, Page 18).

Tab. 10 Measures to be taken if the pump is shut down

Behavior of the pumped liquid	Duration of shutdown (depending on process)	
	Short	Long
Elements of the pumped liquid sediment or crystallize.	▶ Flush the pump.	▶ Flush the pump.
Solidifying/freezing, non-corrosive	▶ Heat up or empty the pump and containers.	▶ Empty the pump and containers.
Solidifying/freezing, corrosive	▶ Heat up or empty the pump and containers.	▶ Empty the pump and containers. ▶ Treat the pump and containers with preservative.
Remains liquid, non-corrosive	–	–
Remains liquid, corrosive	–	▶ Empty the pump and containers. ▶ Treat the pump and containers with preservative.

Tab. 11 Measures depending on the behavior of the pumped liquid

6.4 Start-up following a shutdown period

⚠ DANGER

Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

1. If the pump is shut down for over 1 year, take the following measures before restoring it to service:

Shutdown period	Measure
> 1 year	▶ Check antifriction bearings and replace if necessary.
> 2 years	▶ Replace the elastomer seals (O-rings, shaft sealing rings). ▶ Replace the antifriction bearings.


Tab. 12 Measures to be taken after prolonged shutdown periods


2. Carry out all steps as for the initial start-up (→ 6.1 Putting the pump into service for the first time, Page 28).

6.5 Operating the stand-by pump

- ✓ Stand-by pump filled and bled
- ▶ Operate the stand-by pump at least once a week (→ 6.1 Putting the pump into service for the first time, Page 28).


7 Maintenance

 For pumps in explosion-hazard areas (→ 9.5 ATEX additional instructions, Page 46).

 Trained service technicians are available for fitting and repair work. Present a pumped liquid certificate (DIN safety data sheet or safety certificate) when requesting service.

2. For trouble-free operation, always ensure the following:
 - No dry running
 - No leaks
 - No cavitation
 - Suction-side gate valves open
 - Sufficient suction pressure
 - No unusual running noises or vibrations
 - Magnet coupling may not break off
 - Proper functioning of auxiliary systems

7.1 Inspections

 The inspection intervals depend on the operational strain on the pump.

DANGER

Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

DANGER

Risk of injury due to running pump!

- ▶ Do not touch the running pump.
- ▶ Do not carry out any work on the running pump.


WARNING

Risk of injury and poisoning due to hazardous pumped liquids!


- ▶ Use personal protective equipment when carrying out any work on the pump.

1. Check at appropriate intervals:
 - Adherence to the minimum and maximum flow rates
 - Temperature of antifriction bearings < 90 °C measured at the bearing housing)
 - Normal operating conditions unchanged (differential head, speed, etc.)
 - If present, make sure the pressure relief valve is functioning properly
 - Coupling alignment and condition of elastic parts
 - Filling level in the suction or supply container
 - Filters and strainers (if present)

7.2 Maintenance

 Service life of the antifriction bearings for operation within the permissible operating range: > 2 years

Intermittent operation, high temperatures, low viscosities and aggressive ambient and process conditions reduce the service life of antifriction bearings.

 Mechanical seals are subject to natural wear, which strongly depends on the respective operating conditions. Therefore, general statements regarding their service life cannot be made.

DANGER

Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

DANGER

Risk of injury due to running pump!

- ▶ Do not touch the running pump.
- ▶ Do not carry out any work on the running pump.
- ▶ Isolate the motor from its supply voltage and keep it locked when carrying out any fitting or maintenance work.

DANGER

Risk of death due to electric shock!

- ▶ Have all electrical work carried out by qualified electricians only.

WARNING


Risk of injury and poisoning due to hazardous or hot pumped liquids!

- ▶ Use personal protective equipment when carrying out any work on the pump.
- ▶ Allow the pump to cool down completely before commencing any work.
- ▶ Make sure the pump is depressurized.
- ▶ For pumps with a double jacket housing, ensure that the annulus that separates the inner jacket housing from the jacket housing is depressurised (for example, pump type SHP).
- ▶ Empty the pump, safely collect the pumped liquid and dispose of it in accordance with environmental regulations.

7.2.1 Bearing

1. As a precaution, replace antifriction bearings with lifetime lubrication every 2 years (recommended).
2. As a precautionary measure, replace the low-friction carbon bush every 2 years (recommended).

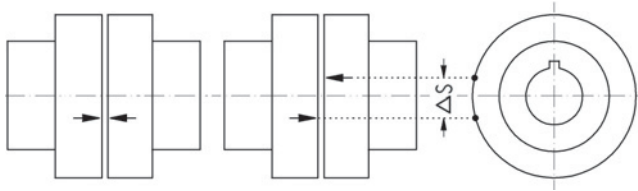
7.2.2 Mechanical seals

 Mechanical seals will always leak a bit, due to the way they work.

- ▶ In the event of major leaks: replace the mechanical seals and their auxiliary seals and check the integrity of the auxiliary systems.

7.2.3 Coupling

1. Check the condition of the coupling and of elastic parts every 1,000 operating hours.



2. Check for coupling wear every 1,000 operating hours.
 - Turn the coupling halves in opposite directions.
 - Mark the position with a pen above both halves of the coupling.
 - Turn the coupling halves in the opposite direction.
 - Mark the position with a pen above both halves of the coupling.
 - Measure distance ΔS between the two markings.

Size	ΔS wear
58	5.5
68	5.5
80	5.0
95	6.0
110	7.0
125	8.0
140	8.0
160	8.0

Tab. 13 Coupling wear

3. Check the coupling alignment and realign the motor if necessary (→ 5.6 Aligning the coupling precisely, Page 26).


7.2.4 Cleaning the pump

NOTE

High water pressure or spray water can damage bearings!

- ▶ Do not clean bearing areas with a water or steam jet.
- ▶ Clean large-scale grime from the pump.

7.3 Dismounting

-  Trained service technicians are available for fitting and repair work. When requesting service, present a pumped medium certificate – DIN safety data sheet or document of compliance (→ 9.2 Safety certificate, Page 42). Repair instructions can be ordered with spare parts if carrying out the repair work yourself.

DANGER

Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

DANGER

Risk of injury due to running pump!

- ▶ Do not touch the running pump.
- ▶ Do not carry out any work on the running pump.
- ▶ Isolate the motor from its supply voltage and keep it locked when carrying out any fitting or maintenance work.

DANGER

Risk of death due to electric shock!

- ▶ Have all electrical work carried out by qualified electricians only.

WARNING

Risk of injury and poisoning due to hazardous or hot pumped liquids!

- ▶ Use personal protective equipment when carrying out any work on the pump.
- ▶ Allow the pump to cool down completely before commencing any work.
- ▶ Make sure the pump is depressurized.
- ▶ For pumps with a double jacket housing, ensure that the annulus that separates the inner jacket housing from the jacket housing is depressurized (for example, pump type SHP).
- ▶ Empty the pump, safely collect the pumped liquid and dispose of it in accordance with environmental regulations.

⚠ WARNING

Risk of injury due to heavy components!

- ▶ Pay attention to the component weight. Lift and transport heavy components using suitable lifting gear.
- ▶ Set down components safely and secure them against overturning or rolling away.

⚠ WARNING

Risk of injury during disassembly!

- ▶ Secure the pressure-side and suction-side gate valves against accidental opening.
- ▶ Wear protective gloves as components can become very sharp through wear or damage.
- ▶ Remove spring-loaded components carefully (e.g. mechanical seal, tensioned bearing, valves etc.), as components can be ejected by the spring tension.
- ▶ Observe the manufacturer's specifications (e.g. for the motor, coupling, mechanical seal, blocking pressure system, cardan shaft, drives, belt drive etc.).

NOTE

Material damage, breakable components!

- ▶ Dismount ceramic parts on the sleeve bearings and magnet coupling carefully (do not allow them to hit anything).

7.3.1 Dismounting

- ✓ Pump depressurized
- ✓ Pump completely empty, flushed and decontaminated
- ✓ For pumps with a double jacket housing, the annulus that separates the outer jacket housing from the inner jacket housing is completely emptied, rinsed and decontaminated.
- ✓ Electrical connections disconnected and motor secured against being switched on again
- ✓ Pump cooled down
- ✓ Deinstall the safety guarding.
- ✓ On couplings with spacer piece: spacer piece removed
- ✓ Auxiliary systems shut down, depressurized and emptied
- ✓ Manometer lines, manometer and holdings dismantled
- ▶ Observe the following during removal:
 - Mark the precise orientation and position of all components before dismantling them.
 - Dismount components concentrically (axially) without canting, starting with the suction side.
 - Dismount the pump (→ sectional drawing).
 - The assembly/disassembly instructions can be requested from the manufacturer if required.


7.3.2 Returning the pump to the manufacturer

1. Enclose a truthfully and fully completed safety certificate when returning pumps or components to the manufacturer. Safety certificates can be ordered from the manufacturer, if necessary.
2. Take necessary measures, depending on the required repair work, as listed in the table below when returning the pump to the manufacturer.

Repairs	Measure for return
...at the customer's premises	▶ Return the defective component to the manufacturer.
...at the manufacturer's premises	▶ Flush the pump and decontaminate it if it was used for hazardous pumped liquids. ▶ Return the complete pump (not disassembled) to the manufacturer.
...at the manufacturer's premises for warranty repairs	▶ Only in the event of hazardous pumped liquid: flush and decontaminate the pump. ▶ Return the complete pump (not disassembled) to the manufacturer.

Tab. 14 Measures for returning the pump

7.4 Installing

 Reinstall the components concentrically, without canting, in accordance with the marks applied.

DANGER

Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

WARNING

Risk of injury due to heavy components!

- ▶ Pay attention to the component weight. Lift and transport heavy components using suitable lifting gear.
- ▶ Set down components safely and secure them against overturning or rolling away.

WARNING

Risk of injury during assembly!

- ▶ Install spring-loaded components carefully (e.g. mechanical seal, tensioned bearing, valves etc.), as components can be ejected by the spring tension.
- ▶ Observe the manufacturer's specifications (e.g. for the motor, coupling, mechanical seal, blocking pressure system, cardan shaft, drives, belt drive etc.).

NOTE

Material damage due to unsuitable components!

- ▶ Always replace lost or damaged screws with screws of the same strength.
- ▶ Only replace seals with seals of the same material.

1. Observe the following during installation:
 - Replace worn parts with genuine spare parts.
 - Replace seals.
 - Observe prescribed tightening torques (these can be requested from the manufacturer if required).
2. Clean all parts. Do not remove any markings that may have been attached.
3. Install the pump (→ sectional drawing).
 - The assembly/disassembly instructions can be requested from the manufacturer if required.
4. Replace/reactivate all safety and protective devices.

5. Install the pump in the system (→ 5 Setup and connection, Page 20).

7.5 Ordering spare parts

- ▶ Have the following information ready to hand when ordering spare parts (→ 3.1.1 Type plate, Page 9).
 - Name
 - Serial number
 - Year of manufacture
 - Part number
 - Designation
 - Quantity
 - Delivery type
 - Delivery address

8 Troubleshooting



Risk of death and material damage due to magnetic field!

- ▶ Make sure that personnel who have a pacemaker do not perform any work on the pump.
- ▶ Secure the work area. If necessary isolate the area:
 - Make sure that personnel with pacemakers keep a safe distance of at least 1 meter.
 - Make sure that no magnetizable metal parts can be attracted by the magnetic coupling of the pump.
 - Make sure that parts of the magnetic coupling cannot be attracted by the magnetizable metal parts.
- ▶ Keep all magnetically-sensitive objects at a safe distance of at least 150 mm from the magnetic coupling.

8.1 Pump malfunctions

If malfunctions occur which are not specified in the following table or cannot be traced back to the specified causes, please consult the manufacturer.

Malfunction	Possible cause	Remedy
Delivery rate too low	Counter-pressure too high	▶ Reset operating point.
	Suction head too high, or supply head too low.	▶ Check the liquid level. ▶ Completely open the suction-side fittings.
	Blocked filter NPSH has not been observed.	▶ Clean the filters and dirt traps on the suction side.
	Gaps in sealing have become too large due to wear.	▶ Replace the worn pump parts.
	Incorrect sense of rotation or rotational speed	▶ Connect motor properly.
	Housing or suction line leaky	▶ Replace the housing seal. ▶ Check the flange connections.
No pump suction	Suction line or shaft seal on suction side leaky	▶ Replace the housing seal. ▶ Check the flange connections.
	Suction head excessive	▶ Check the liquid level.
	Gaps between impeller and stage too large due to wear and tear	▶ Replace the worn pump parts.
	Incorrect sense of rotation	▶ Connect motor properly.
	Fluid reserve in pump too low	▶ Fill the pump.
	Suction or pressure gate valve closed	▶ Open the gate valve.
	Incorrect pipe connection	▶ Connect pump properly.
	Incorrect electrical connection	▶ Connect motor properly.
	NPSH has not been observed.	▶ Clean the filters and dirt traps on the suction side.
Screw plugs still in place	▶ Remove the screw plugs.	


Malfunction	Possible cause	Remedy
Pump leaking	Housing screw joints leaky	▶ Check the tightening torque of the housing screw joints and correct if necessary.
	Pump is distorted.	▶ Check that piping is stress-free.
	Seals faulty	▶ Replace seals.
Temperature increase in the pump	Pump or pipe not filled completely	▶ Bleed and fill pump and suction and supply lines.
	Suction head too high, or supply head too low.	▶ Check the liquid level. ▶ Open the suction-side shut-off devices.
	Pump running dry	▶ Clean the filters and dirt traps on the suction side.
Pump running roughly or noisily	Suction head too high, or supply head too low (cavitation).	▶ Check the liquid level. ▶ Open the suction-side shut-off devices.
	Q_{min} is below the minimum	▶ Clean the filters and dirt traps on the suction side.
	Pump or pipe not filled completely or pump is cavity	▶ Bleed and fill pump and suction and supply lines.
	Pump is cavitating	▶ Check supply ratios, supply pressure and temperature of pumped medium ($NPSH_{pump} < NPSH_{system}$)
	The existing max. torque of the magnetic coupling was exceeded, i.e. the magnetic coupling has been torn off.	▶ Check whether the pump has been blocked by contaminants (pump running smoothly). ▶ Check the internal sleeve bearings. ▶ Check the operating conditions (→ data sheet/performance curve). ▶ Check the maximum permissible density of the pumped liquid (→ data sheet/performance curve).
	Pump is not positioned evenly on the ground or is distorted.	▶ Check the pump setup.
	Foreign particles in the pump	▶ Dismantle and clean the pump.
	Coupling worn and/or aligned incorrectly	▶ Check for wear and tear and check the coupling alignment.
	Motor running on 2 phases	▶ Check pipe insulation and connections, as well as the fuse.
Antifriction bearing defective	▶ Check that the pump is running smoothly.	

Malfunction	Possible cause	Remedy
Motor protection switch moves to off position	Foreign particles in the pump	▶ Dismantle the pump and replace damaged parts.
	Closed gate valve in the pressure line	▶ Open the gate valve.
	Permissible pumping conditions are not being observed.	▶ Check the operating conditions (→ data sheet/performance curve).
	Power consumption is greater than the top limit value.	▶ Check the motor protection switch and the electrical connection.
	Friction increase in the pump	▶ Check the following conditions: <ul style="list-style-type: none"> • Pump blocked by contaminants • Shaft bearing worn • Stuffing box bolted too tightly • Viscosity and/or density of pumped liquid increased
No pumping action, although motor is running	The existing max. torque of the magnetic coupling was exceeded, i.e. the magnetic coupling has been torn off.	▶ Check whether the pump has been blocked by contaminants (pump running smoothly). ▶ Check the internal sleeve bearings. ▶ Check the operating conditions (→ data sheet/performance curve). ▶ Check the maximum permissible density of the pumped liquid (→ data sheet/performance curve). ▶ Check the arrangement of the magnetic coupling – motor – pump (→ data sheet/performance curve).


Tab. 15 Troubleshooting list

9 Appendix

9.1 Technical specifications

 Further technical specifications (→ data sheet/performance curve)

9.1.1 Ambient conditions

 Operation under any other ambient conditions should be agreed with the manufacturer.

Temperature [°C]	Relative humidity [%]	
	Long-term	Short-term
-10 to 40	≤ 85	≤ 100

Tab. 16 Ambient conditions

9.1.2 Weight

(→ Delivery note)

9.1.3 Sound pressure level

Expected noise levels for side channel pumps at a speed of $n = 1450 \text{ min}^{-1}$.

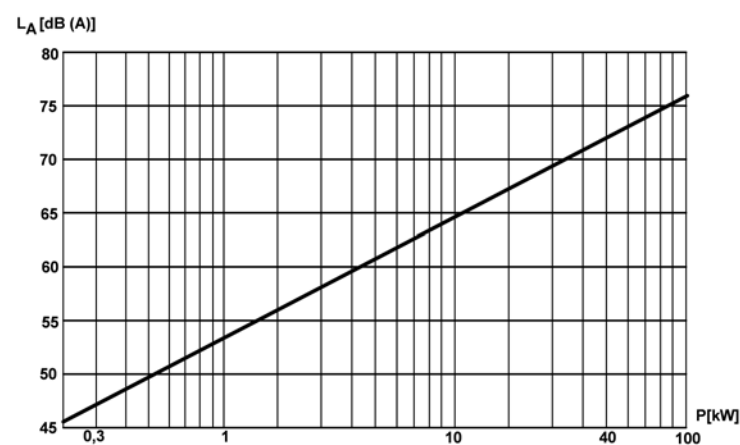




Fig. 13 Sound pressure level

9.2 Safety certificate

 Please copy this document and send it together with the pump.

The pump and accessories submitted for inspection / repairs together with the safety certificate by us, the signatory:	
Type: _____	Delivery date: _____
Part no.: _____	Order no.: _____
Reason for inspection / repair: _____	
<p><input type="checkbox"/> Was not used with liquids that are hazardous to health or the environment.</p> <p><input type="checkbox"/> Was used for the following application: _____</p> <p style="padding-left: 40px;">and came into contact with liquids that must be labeled for safety or are considered to be polluting.</p> <p><input type="checkbox"/> Last pumped liquid: _____</p> <p><input type="checkbox"/> The pump has been carefully emptied and cleaned on the outside and inside prior to delivery or provision.</p> <p><input type="checkbox"/> Special safety precautions are not necessary for subsequent handling.</p> <p><input type="checkbox"/> For a pump with a double jacket housing, the annulus that separates the outer jacket housing from the inner jacket housing has been completely emptied and cleaned on the inside (for example, pump type SHP).</p> <p><input type="checkbox"/> The following safety precautions regarding rinsing liquids, liquid residue and disposal are necessary: _____</p>	
	If the pump was used with critical liquids, please make sure you enclose a safety data sheet in the package.
We hereby declare that the information given is correct and complete, and that the pump is being shipped in accordance with legal requirements.	
Company / address: _____	Phone: _____
	Fax: _____
Customer no.: _____	
Issuer name: (capital letters) _____	Position: _____
Date: _____	Company stamp / signature: _____

Tab. 17 Safety certificate

9.3 Declarations according to EC machine directives

9.3.1 Declaration of conformity according to EC machine directives

Declaration of conformity to EC Machine Directive 2006 / 42 / EC, Appendix II 1A

We hereby declare that the design and layout of the machine described below, as well as the variant thereof put into circulation by us, conforms to the relevant basic safety and health protection requirements of the EC Machine Directive.

If any unauthorized changes or made to the unit, and/or it is used in a manner other than that intended, this declaration loses its validity.

Pump unit for pumping fluids

Description/series _____

Serial number _____

Relevant regulations:

- Machine Directive (2006/42/EC)

Applicable harmonized norms:

- EN 809:1998+A1:2009 + AC:2010
- EN ISO 12100:2010

Date: 04/11/2019

The officer responsible for documentation compiles the technical documents.

Tab. 18 Declaration of conformity according to EC machine directives

9.3.2 Declaration of installation according to EC machine directive

Declaration of installation

conforming to EC Machine Directive 2006 / 42 / EC , Appendix II 1B

We hereby declare that the incomplete machine described below is intended to be fitted into a machine/joined to other machines. Basic safety and health protection requirements of the EC Machine Directive are applicable and are complied with. The special technical documents have been drawn up in accordance with Appendix VII, Part B. The incomplete machine may not be commissioned until it has been established that the machine into which the incomplete machine is to be fitted complies with the provisions of EC Machine Directive 2006 / 42 / EC.

Pump unit for pumping fluids

Description/series _____

Serial number _____

The following basic safety and health protection requirements (2006 / 42 / EC, Appendix I) are complied with:

- 1.1.2. – Principles of safety integration a) to d)
- 1.1.3 – Materials and products
- 1.1.5. – Design of machinery to facilitate its handling

Applicable harmonized norms:

- EN 809:1998+A1:2009 + AC:2010
- EN ISO 12100:2010

Date: 04/11/2019

The officer responsible for documentation compiles the technical documents. If a reasonable request is made by national authorities, we undertake to supply the special technical documents in printed form by courier.

Tab. 19 Declaration of installation according to EC Machine Directive

9.4 Short instructions for commissioning a pump unit delivered complete



Danger of death!

- ▶ Read and observe the complete operating manual, in particular the warning notices and the general safety notices.

Preparing the pump unit:

- Pumped medium
 - may not crystallize
 - no solids with an aggressive effect
- Remove the blind plugs before connecting the pipes.
- If the pump has been treated:
 - drain preservative
 - dispose of preservative properly
 - clean the pump

Installing the pump unit:

- Align the pump unit on the foundation and fix it in place.
- Clean and connect pipes, observing the sense of flow and rotation (see arrows on pump).

Starting-up the pump unit:

- Fill the pump with liquid (pump must have been bled completely).
- Open all shut-off fittings in the suction and pressure pipes.
- Check that the safety guarding is installed and that all safety devices are operational.
- The electrical connection must be established by a qualified electrician!
 - Provide a motor protection switch
 - Check the voltage, speed and sense of rotation.
- Turn the unit by hand and make sure that it turns easily and evenly.
- Switch on the motor.
- After powering up to operational speed, check the operational pressure at the manometer. If necessary, adjust the operating point by throttling the pressure side.

Operating the pump unit

- The flow rate may not drop below the minimum.
- Fluid must flow into the pump at all times: It cannot be allowed to run dry!
- Never touch a pump while it is in operation, as it could be hot/cold.
- Power consumption increases as the differential head increases and the flow rate decreases.
- Pipes may not transmit electrical voltage to the pump, either during assembly or during operation.

9.5 ATEX additional instructions

Additional requirements for safe operation in areas at risk of explosion.

9.5.1 Safety

Intended use

The pump, as non-electrical equipment, satisfies the device requirements for equipment in equipment group II, categories 2 and 3.

Do not use pump if

- any valves are closed.
- the operating range is exceeded in any way (→ data sheet/performance curve).
- the maintenance interval has been exceeded.

Obligations of the operating company

- Evaluate and document the operating areas of the system for danger of explosions in accordance with Directive 99/92/EC, appendix I.
- Ensure that Directive 99/92/EC is observed to protect the health and safety of employees in potentially explosive atmospheres.
- Only operate the pump according to the explosion protection labeling.
- Always ensure that the following conditions are met:
 - the pump is earthed.
 - there is no contact between the coupling and the safety guarding.
 - pump interior, seal chamber, auxiliary systems and vacuum and pressure pipes are always completely filled with the liquid being transported.
 - the maximum permissible surface temperature of the pump is not exceeded.
 - fittings on the suction and pressure side of the pump are set correctly.
 - the pump is regularly maintained and monitored.
 - dry running must be prevented under all circumstances, e.g. by use of level monitoring or a flow indicator.
- Ensure that the motors, couplings and monitoring units supplied on site actually correspond to the category and temperature class of the associated zone.
- Note the data sheet/performance curve supplied.
- Inform personnel about special dangers:
 - Danger of explosions when removing dust build-up
- Ensure that maintenance and repair work are only carried out by authorized personnel who:
 - are familiar with the standards and regulations for using devices in potentially explosive areas
 - possess the required knowledge and experience for handling devices when used in potentially explosive areas

- After maintenance and repair work, the pump unit may only be approved for operation by authorized personnel, an officially recognized person or by the pump manufacturer.
- Ensure that the following actions are carried out following significant modifications to the pump unit (e.g. seal materials, seal versions, auxiliary seals, hydraulics):
 - A new ignition hazard assessment is carried out.
 - The pump unit is inspected in accordance with the latest technology and the requirements of the Directive 2014/34/EU
 - The modifications are documented in the explosion protection document of the operator according to Directive 1999/92/EC, or in the conformity assessment procedures according to Directive 2014/34/EU with the issue of a declaration of conformity.


Materials and pumped liquids

Ensure that:

- all components are electrically conductive.
- the build up of static electricity is avoided.

9.5.2 Explosion protection mark

Label

 This information on the explosion protection marking is generally valid.

The pump is labeled as follows:

Temperature class (→ data sheet/performance curve).

The labeling on the pump in conjunction with the data sheet as a non-electrical device according to Directive 2014/34 / EU applies to the delivered pump unit. The motor included has an additional and separate label.

If the pump is delivered without a motor, the attached label only applies to the pump. In this case, the operator is responsible for equipping the pump with a suitable motor in accordance with the requirements of Directives 2014/34/EU and 2006/42/EC and assessing their conformity with these Directives.

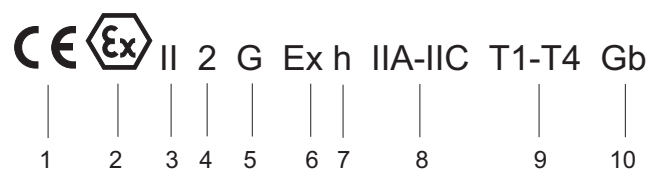


Fig. 14 Explosion protection labeling on the pump (equipment group II, category 2)

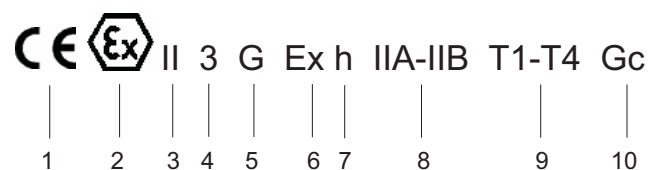



Fig. 15 Explosion protection labeling on the pump (equipment group II, category 3)

- 1 CE label
- 2 Ex label according to Directive 2014/34/EU
- 3 Equipment group according to directive
- 4 Equipment category according to directive
- 5 Ex atmosphere
- 6 Ex label according to standard DIN EN ISO 80079-36
- 7 Type of protection against ignition / identification code according to standard DIN EN ISO 80079-37
- 8 Gas group
- 9 Temperature class
- 10 Equipment Protection Level (EPL)


Temperature class

 Flammable gases and vapors are divided into temperature classes for their inflammability on hot surfaces.

The surface temperature of the pump must always be less than the lowest ignition temperature of the temperature class.

Temperature class	Lowest ignition temperature of the mixtures [°C]	Maximum surface temperature [°C]
T1	450	< 450
T2	300	< 300
T3	200	< 200
T4	135	< 135
T5	100	< 100
T6	85	< 85

Tab. 20 Temperature class

 The pump may only be operated up to the temperature class specified on the type plate.

Type of protection against ignition

The **type of protection against ignition** describes the type of measures used to prevent ignition in a potentially explosive atmosphere.

The label consists of the symbol Ex (explosion protection) and a letter describing the type of protection against ignition.

Type of protection against ignition	Meaning	For an area	
		with non electrical equipment	with electrical equipment
Ex h	Ignition source monitoring	X	–
	Safe design	X	–
	Liquid encapsulation	X	–

Tab. 21 Type of protection against ignition

Ex atmosphere

The **Ex atmosphere** describes the type of potentially explosive atmosphere in a zone.

Ex atmosphere	Meaning
G	Flammable gases and vapors

Tab. 22 Ex atmosphere

Zone / equipment group / area of use / category

The **zone** depends on the probability of the occurrence of an explosive atmosphere.


Pumps are divided by area of use into **groups** or **equipment groups** and **equipment protection level (EPL)** or **categories**.

The **category** or **equipment protection level (EPL)** describes the safe design of the pump and depends on the zone.

Zone	Frequency of occurrence of dangerous explosive atmosphere	Classification in accordance with EN 80079-36		Classification in accordance with RL 2014/34/EU		Design safety
		Group	EPL	Equipment group / area of use	Category	
1	occasionally (any faults occurring may not become a source of ignition)	II	Gb	II / other	2G	high
2	unlikely; if it does occur, then rarely and short-term (in normal operation, surface temperature may not become source of ignition in normal operation)	II	Gc	II / other	3G	normal

Tab. 23 Zone / equipment group / area of use / category

9.5.3 Installation and connection

 The measures to install and connect depend upon the category (→ 9.5.2 Explosion protection mark, Page 47).

Basic measures

- Observe the operating manuals for the motor, coupling and monitoring devices.
- Only use contact guards made from electrically conductive components.
- Secure the grub screw to fix the coupling halves with Loctite (medium strength).
- For aluminum safety guarding:
 - Remove swarf and dirt from the safety guarding.
- For pumps with motors supplied by the operator:
 - Motor must correspond to the requirements (group, category) in explosion-hazard areas.
- Install a slow-closing non-return member between the outlet flange and the gate valve to ensure that the pumped liquid does not flow back when the pump is switched off.
- If a frequency converter is used:
 - Check with the pump manufacturer whether it may be used.
- Grounding and electrical bonding for base plate pump:
 - Ensure electrical bonding of the pump unit.
 - Mark grounding cable according to local regulations.
- Grounding and electrical bonding:
 - Ensure that the mounting surface of the motor is metallically bare.
- Observe additional information on the prevention of ignition hazards caused by electrostatic charging:
 - for example, Technischen Regeln für Gefahrstoffe (for example, Technical Rules for Hazardous Substances) (TRGS 727)
- For use of pumped fluids with a conductivity $< 10^{-8}$ S/m:
 - Ensure a flow rate in the suction pipe < 1 m/s (→ 5.2.2 Specifying nominal diameters, Page 21).
 - Ground the pump

Adhere to the requirements for ignition source monitoring

- Ensure ignition source monitoring in accordance with the minimum requirements for the equipment protection level according to DIN EN ISO 80079-37.
 - Type of protection against ignition b1 for equipment protection level (EPL) Gb and equipment category 2 (DIN EN ISO 80079-37, Appendix E4)
- Ensure the evaluation of another monitoring device with the corresponding proven reliability according to DIN EN ISO 80079-37.

Measures for category 2 equipment

Ensure there is monitoring equipment to prevent overheating due to dry running.

Type and design of the shaft seal ¹⁾	Measure
Single mechanical seal	If the pumped liquid contains gas: <ul style="list-style-type: none"> ▶ If possible, retrofit the temperature gauge. ▶ Retrofit dry run monitoring.
Double mechanical seal arranged back-to-back	▶ Include a pressure gauge for the sealing medium.
Double mechanical seal in tandem arrangement	▶ If necessary, fit level measurement device for the supply container.
Single mechanical seal with quench and a secondary seal with lip seal	▶ If the temperature difference between sealing medium and temperature class < 15 Kelvin: Include a temperature gauge for the barrier medium.
Magnetic coupling	▶ Include the following monitoring devices: <ul style="list-style-type: none"> – Motor load monitor – Separating can temperature monitor – Fill level monitor

Tab. 24 Possible control measures to avoid dry running with resulting impermissible overheating
1) (→ data sheet/performance curve)

Monitor the system according to the behavior of the parameters:

Parameters ¹⁾	Measure
Constant	<ul style="list-style-type: none"> ▶ Monitor the motor power: <ul style="list-style-type: none"> – Reaction time < 5 s – Accuracy < 15% – Recording of active power of all three phases – Monitoring of excessive and insufficient load (→ data sheet/performance curve) ▶ Alternatively: Monitor the flow rate and/or tank level
At least one not constant	<ul style="list-style-type: none"> ▶ Monitor the flow rate and/or tank level <ul style="list-style-type: none"> – Reaction time < 5 s – Monitoring of minimum and maximum load (→ data sheet/performance curve)

Tab. 25 Measures to prevent impermissible overheating
 1) Flow rate, differential head, density, viscosity, speed of rotation, flow quantity

9.5.4 Operation

Staying within maximum permissible operating temperatures


Stay within the maximum permissible operating temperature of the pump (→ data sheet/performance curve):

Staying within the maximum permissible temperature of the pumped liquid

Temperature class	Permissible temperature of the pumped medium [°C] ¹⁾
T4	80
T3	145
T2	240
T1	390

Tab. 26 Max. pumped liquid temperature
 1) Applies to specific heat capacity of water ($c_{\text{water}} = 4.2 \text{ KJ/kgK}$) and at speeds < 1450 min⁻¹

Staying within the maximum permissible temperature of the heating medium

 Agree electrically operated heating systems with the manufacturer.

Stay within maximum permissible temperature of the heating medium (→ table):

- Compare the value in the table with the maximum permissible temperature of the housing surface.
- Use the lower value as the maximum permissible value.

Temperature class	Permissible temperature of the heating medium [°C] ¹⁾
T4	80
T3	145
T2	220
T1	220


Tab. 27 Max. heating medium temperature

Safe operation

Ensure the following operating conditions:

- No dry running
- Do not run overloaded
- Do not run while suction-side fittings are closed
- Do not run while pressure-side fittings are closed (even briefly while powering up)
- Bleed the mechanical seal area regularly
- Cooling function of the mechanical seal for K-pumps (if present)

9.5.5 Maintenance

 Maintenance intervals are reduced for more difficult operating conditions.

Carrying out measures

Change the motor antifriction bearings as specified by the manufacturer.

As a precaution, replace pump antifriction bearings after 10,000 operating hours if the condition of bearings is not monitored. Change pump antifriction bearing after 17,500 hours.

Check at appropriate intervals:

- Excessive heating and increased vibration of bearing bracket and bearing housing
- the motor and coupling according to the manufacturer's operating instructions
- Surface temperatures of motor and pump
- Changes to running noises or vibrations
- Deformation of the safety guarding and spacing to the rotating parts
- the functioning of the monitoring devices

