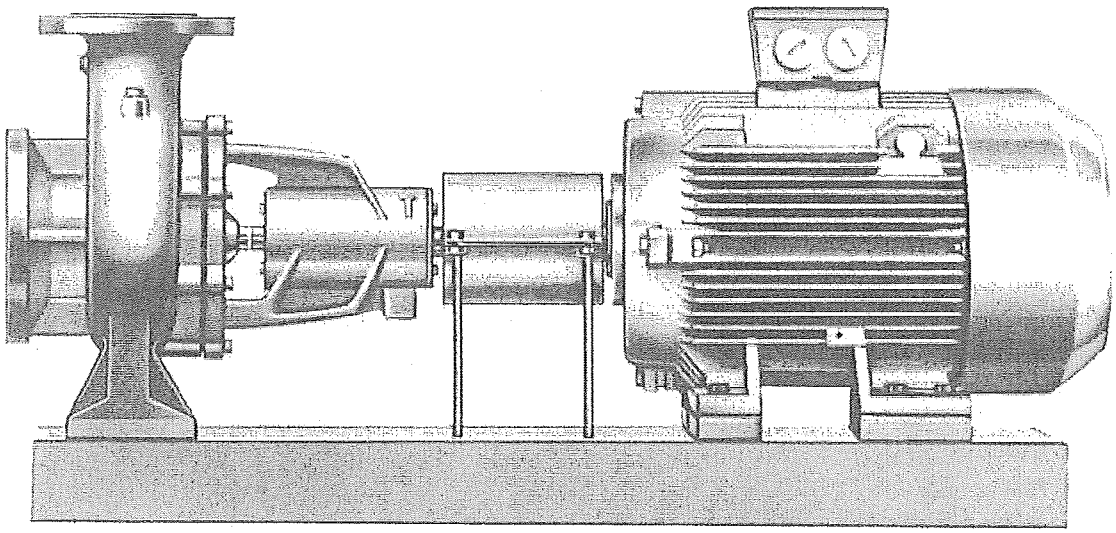
ALLWEILER

# Centrifugal Pump with Volute Casing

## Operating manual NT series

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# 1 About this document

This manual

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

## 1.1 Target groups

| Target group | Duty |
|---|---|
| Operating company | ▶ Keep this manual available at the site of operation of the system, including for later use.<br>▶ Ensure that personnel read and follow the instructions in this manual and the other applicable documents, especially all safety instructions and warnings.<br>▶ Observe any additional rules and regulations referring to the system. |
| Qualified personnel, fitter | ▶ 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 |
|---|---|
| ATEX additional instructions | Operation in explosion hazard areas |
| Order data sheet | Technical specifications, conditions of operation |
| Setup drawing | Setup dimensions, connection dimensions etc. |
| Technical description | Technical specifications, operating limits |
| Sectional drawing | Sectional drawing, part numbers, component designations |
| Supplier documentation | Technical documentation for parts supplied by subcontractors |
| Spare parts list | Ordering spare parts |
| Declaration of conformity | Conformity with standards |

Tab. 2 Other applicable documents and their purpose

## 1.3 Warnings and symbols

| Warning | Risk level | Consequences of disregard |
|---|---|---|
| ⚠ DANGER | Immediate acute risk | Death, grievous bodily harm |
| ⚠ WARNING | Potentially acute risk | Death, grievous bodily harm |
| ⚠ CAUTION | Potentially hazardous situation | Minor bodily harm |
| CAUTION | Potentially hazardous situation | Material damage |

Tab. 3 Warnings and consequences of disregarding them

| Symbol | Meaning |
|---|---|
| ⚠ | Safety warning sign<br>▶ 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 |
| ℹ | Information, advice |

Tab. 4 Symbols and their meaning

## 1.4 Technical terms

| Term | Meaning |
|---|---|
| Sealing medium | Medium as seal barrier/buffer fluid or for quenching of shaft seals |
| Auxiliary systems | Systems for operating the pump |

Tab. 5 Technical terms and their meaning

# 2 Safety

The manufacturer does not accept any liability for damage resulting from disregard of the entire documentation.

## 2.1 Intended use

- Only use the pump for pumping the agreed pumped media (→ order data sheet).
- Adhere to the operating limits and size-dependent minimum flow rate.
- Avoid dry running:
  Initial damage, such as destruction of the mechanical seal and plastic parts, will occur within only a few seconds.
  – Make sure the pump is only operated with, and never without, a pumped medium.
- Avoid cavitation:
  – Fully open the suction-side armature and do not use it to adjust the flow rate.
  – Do not open the pressure-side armature beyond the agreed operating point.
- Avoid overheating:
  – Do not operate the pump while the pressure-side armature is closed.
  – Observe the minimum flow rate (→ order data sheet).
- Avoid damage to the motor:
  – Do not open the pressure-side armature beyond the agreed operating point.
  – Note the maximum permissible number of times the motor can be switched on per hour (→ manufacturer's specifications).
- 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 (→ order data sheet).
- The power consumed by the pump will increase with increasing density of the pumped medium. To avoid overloading the pump, coupling or motor, stay within the agreed density (→ order data sheet).
  Lower densities are allowed. Adapt the auxiliary systems accordingly.
- When pumping liquids containing solids, ensure that the limits for the proportion of solids and the grain size are maintained (→ order data sheet, technical description).
- When using auxiliary systems, ensure that there is a continuous supply of the appropriate medium.

## 2.2 General safety instructions

Take note of 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 involve risks to life and health of the user or third parties and risk of damage to the pump and other property.

- Only operate the pump if it is in perfect technical condition and only use it as intended, staying 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 expose personnel or third parties to any risk.
- Should there be any safety-relevant fault, shut down the pump immediately and have the fault corrected by appropriate personnel.
- In addition to the entire documentation for the product, always comply with statutory or other safety and accident-prevention regulations and with 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, staying 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 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 work.
- Organize responsibilities, who is in charge of any specific duty and how personnel is supervised.
- Ensure that all work is carried out by specialist technicians only:
  - Fitting, repair and maintenance work
  - Work on the electrical system
- Make sure trainee personnel is supervised by a specialist technician when working on the pump.

**Safety equipment**

- Provide the following safety equipment and verify their functionality:
  - For hot, cold and moving parts: guard provided by the customer to prevent contact with 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 original parts or parts that have been approved by the manufacturer.

### 2.2.3 Duties of the personnel

- All directions given on the pump must be followed (and kept legible), e.g. the arrow indicating the direction of rotation and the markings for fluid connections.
- Do not remove the guards to prevent contact with hot, cold or moving parts during operation.
- Use protective equipment if necessary.
- Only carry out work on the pump while it is not running.
- Isolate the motor from its supply voltage and keep it locked in that state when carrying out any fitting or maintenance work.
- Reinstall the safety equipment on the pump as required by regulations after any work on the pump.

## 2.3 Special hazards

### 2.3.1 Explosion hazard area

- (→ ATEX additional instructions).

### 2.3.2 Hazardous pumped media

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

# 3 Layout and function

## 3.1 Labels

### 3.1.1 Type plate

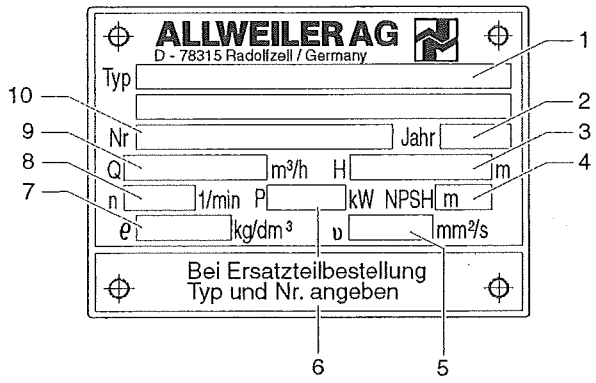



Fig. 1 Type plate (example)

1 Pump type
2 Year of manufacture
3 Differential head
4 Pump NPSH value
5 Kinematic viscosity
6 Power consumption
7 Density
8 Motor speed
9 Flow rate
10 Serial number

### 3.1.2 ATEX plate

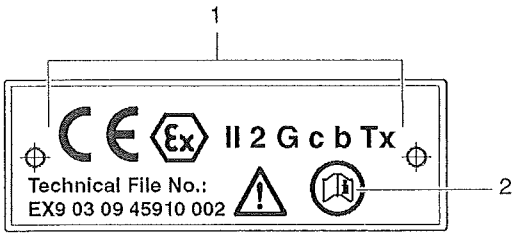



Fig. 2 ATEX plate (example)

1 Explosion protection mark
2 Reference to ATEX additional instructions

### 3.1.3 Pump type code

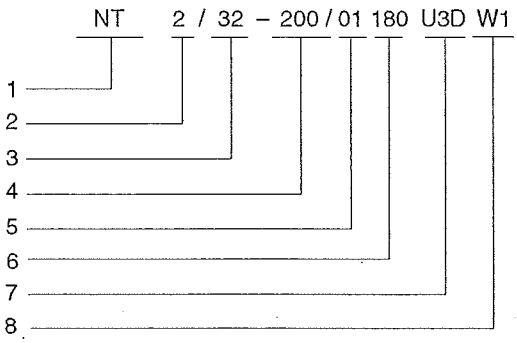



Fig. 3 Pump type code (example)

1 Series
2 Number of stages (only for two-stage pump)
3 Pressure flange DN [mm]
4 Nominal impeller diameter [mm]
5 Hydraulic number
6 Actual impeller diameter [mm]
7 Shaft seal
8 Material key

## 3.2 Layout

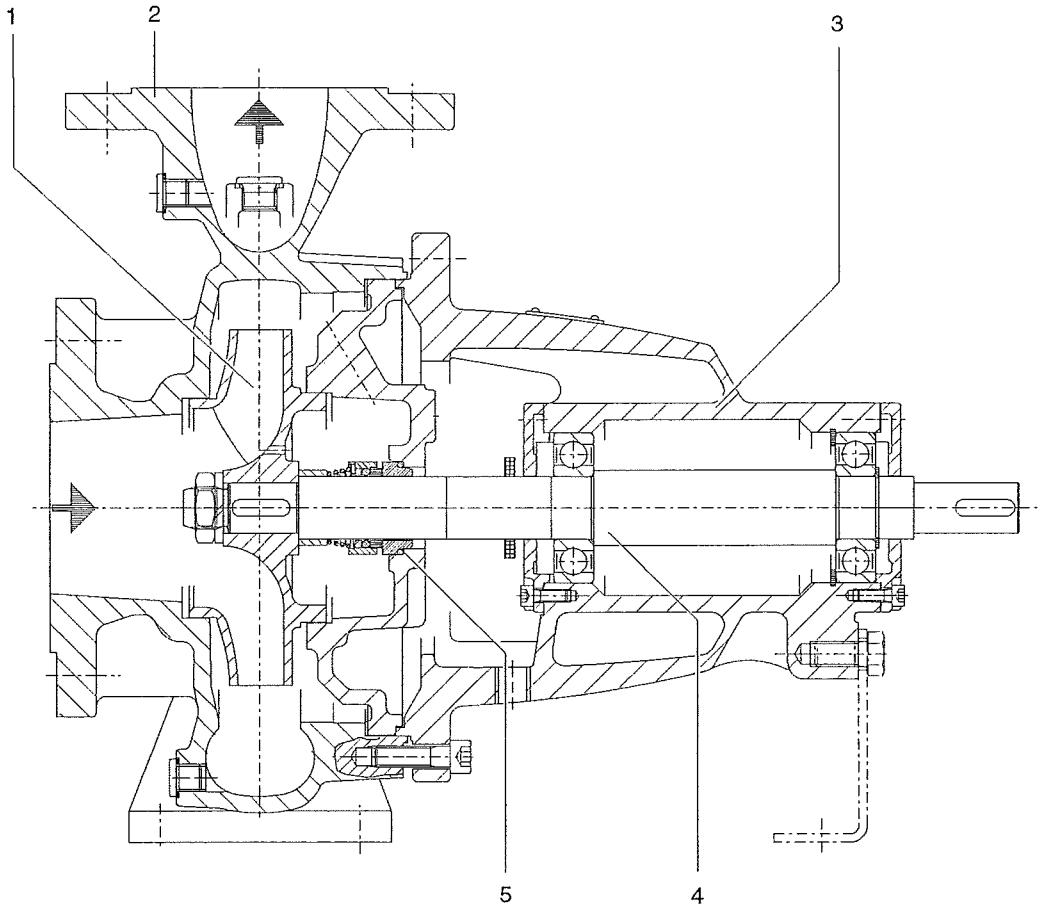



Fig. 4 NT layout

1 Impeller
2 Volute casing
3 Bearing bracket
4 Shaft
5 Shaft seal

## 3.3 Shaft seals

Only one of the following shaft seals can be used.

### 3.3.1 Mechanical seals

Mechanical seals have functional leaks.

- Single mechanical seal
- Single mechanical seal with quenching

### 3.3.2 Packing gland

The packing gland must always leak slightly to carry the frictional heat away.

## 3.4 Auxiliary systems

### 3.4.1 Sealing systems

**Quenching**

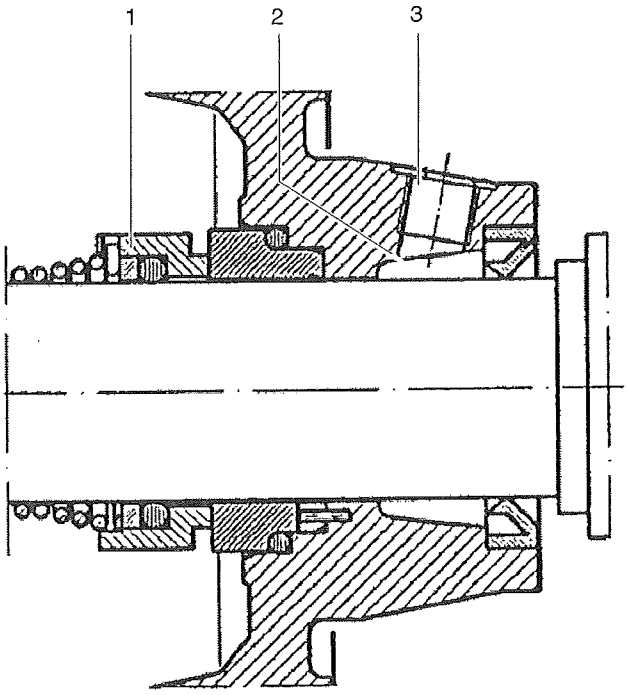



Fig. 5 Single mechanical seal with quenching (sketch)

1 Seal
2 Quench space
3 Quench medium connection

During quenching, the pressure of the pumped medium exceeds the pressure of the sealing medium. The seal surfaces are lubricated by the pumped medium.

Application examples:

- Pumped media that can crystallize in the atmosphere and thus cause damage to the seal in the long-term
- Prevention of offensive odors
- Cooling of seals

| Variant | Characteristics of the sealing medium |
|---|---|
| Open flow system | • Supplied and drained continuously<br>• Unpressurized |
| Closed flow system | • Circulates in a closed cycle<br>• Unpressurized |

Tab. 6 Quenching - variants and characteristics

# 4 Transport, storage and disposal

## 4.1 Transport

For details of weight (→ documents for the particular order).

### 4.1.1 Unpacking and inspection on delivery

1. Unpack the pump/aggregate on delivery and inspect it for damage.
2. Report any damage to the manufacturer immediately.
3. Dispose of packaging material according to local regulations.

### 4.1.2 Lifting

**⚠ DANGER**

**Death or crushing of limbs caused by falling or overturning loads!**

- ▶ Use lifting gear appropriate for the total weight to be transported.
- ▶ Fasten the lifting gear as illustrated below.
- ▶ Do not stand under suspended loads.
- ▶ Set the load down on a level surface.
- ▶ If the pump has a support foot, attach the support foot to the pump.
- ▶ If the pump does not have a support foot, use a base provided by the customer.

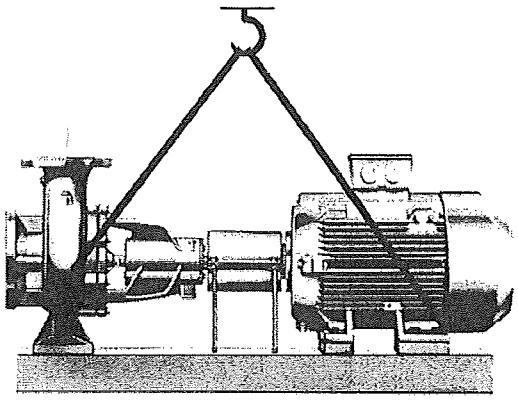


Fig. 6 Fastening the lifting gear to the pump aggregate

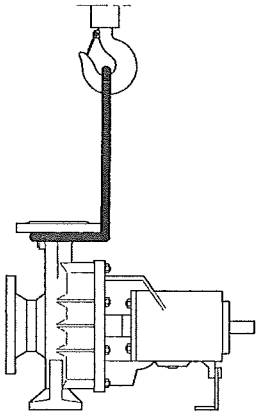


Fig. 7 Fastening the lifting gear to the pump

- ▶ Lift the pump/aggregate properly.

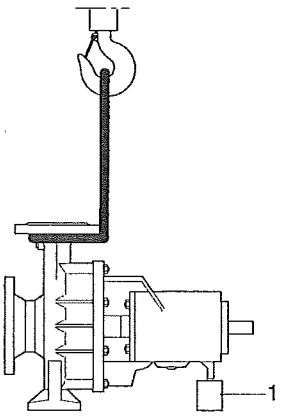



Fig. 8 Setting down the pump without an installed support foot

1 Base

- ▶ Set down the pump properly.

## 4.2 Preservation

Not necessary for non-rusting materials

**CAUTION**

**Material damage due to inappropriate treatment for storage!**

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

1. Choose a preservative appropriate for the type and duration of storage (→ 9.2.7 Preservatives, Page 41).
2. Use the preservative specified by the manufacturer.
3. All bare metal parts should be treated, inside and outside.

## 4.3 Storage

**CAUTION**

**Material damage due to inappropriate storage!**

- ▶ Treat and store the pump properly.

1. Seal all openings with blind 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 a month.
4. Make sure the shaft and bearing change their rotational position in the process.

## 4.4 Removing the preservative

Only necessary for pumps treated with preservative

**⚠ 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 medium (→ 9.2.5 Cleaning agents, Page 40).
- ▶ Completely remove all preservative.

**CAUTION**

**High water pressure or spray water can damage bearings!**

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

**CAUTION**

**Damage to seals due to incorrect cleaning agent!**

- ▶ Ensure the cleaning agent does not corrode the seals.

1. Choose a suitable cleaning agent for the application. (→ 9.2.5 Cleaning agents, Page 40).

With Tectyl 506 EH: allow benzine to soak in for 10 minutes (recommended).

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

Plastic parts can be contaminated by poisonous or radioactive pumped media to such an extent that cleaning is insufficient.

**⚠ WARNING**

**Risk of poisoning and environmental damage caused by pumped medium or oil!**

- ▶ Use protective equipment when carrying out any work on the pump.
- ▶ Prior to disposal of the pump:
  - Catch and dispose of any escaping pumped medium or oil in accordance with local regulations.
  - Neutralize residues of pumped medium in the pump.
  - Remove any preservative (→ 4.4 Removing the preservative , Page 13).
- ▶ Remove and dispose of any plastic parts in accordance with local regulations.

- ▶ Dispose of the pump in accordance with local regulations.

# 5 Setup and connection

For pumps in explosion hazard areas (→ ATEX additional instructions).

**CAUTION**

**Material damage caused by dirt!**

- Do not remove the transport seals until immediately before setting up the pump.
- Do not remove any covers and transport and sealing covers until immediately before connecting the piping to the pump.

## 5.1 Preparing the setup

### 5.1.1 Checking the ambient conditions

- Make sure the required ambient conditions are fulfilled (→ 9.2.1 Ambient conditions, Page 39).

### 5.1.2 Preparing the installation site

- Ensure the installation site meets the following conditions:
  - Pump is freely accessible from all sides
  - Sufficient space for 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

### 5.1.3 Preparing the foundation and surface

Setup options:
- With concrete foundation
- With steel foundation frame
- Without foundation

- Make sure the foundation and surface meet the following conditions:
  - Level
  - Clean (no oil, dust or other impurities)
  - Foundation and surface can support the weight of the pump aggregate and all operating forces
  - Ensure that the pump is stable and cannot tip over
  - For concrete foundation: standard concrete of strength class B 25

### 5.1.4 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 13).

### 5.1.5 Installing the heat insulation

Only necessary to maintain the temperature of the pumped medium

**CAUTION**

**Material damage caused by overheating!**

- Only install the heat insulation on the volute casing.

- Install the heat insulation properly.

## 5.2 Setup with foundation

**CAUTION**

**Material damage due to distortion of the base plate!**

▶ Place the base plate on the foundation and fasten it to it as described in the following.

### 5.2.1 Setting the pump aggregate on the foundation

✔ Implements, tools and materials:
- Foundation bolts (→ setup drawing)
- Steel washers
- Non-shrinking mortar/concrete
- Spirit level

1. Lift the pump aggregate (→ 4.1 Transport, Page 12).
2. Working from below, locate the foundation bolts in the base plate fixing holes.

ℹ Follow the manufacturer's instructions when using adhesive anchors.

3. Set the pump aggregate down onto the foundation. When doing this, sink the foundation bolts into the prepared anchoring holes.

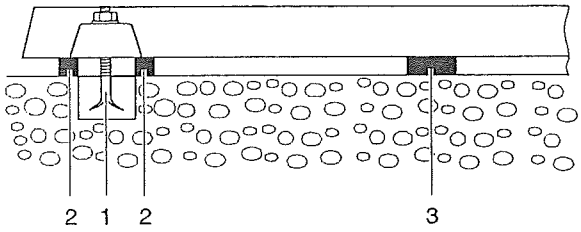



Fig. 9 Setup with foundation

4. Use steel washers to align the pump aggregate to the height and system dimensions as described in the following:
   - Place a steel washer (2) to the left and right of each foundation bolt (1).
   - If the spacing between the anchoring holes > 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 levels to check that the pump is level end to end and side to side with max. 1 mm/m allowable tilt.
7. Repeat the procedure until the base plate is correctly aligned.

### 5.2.2 Fixing the pump aggregate

ℹ The damping behavior is improved by filling the base plate with mortar grout.

1. Fill the anchoring holes with mortar grout.
2. When the concrete has set, bolt down the base plate with the specified torque at three points.
3. Before tightening the remaining bolts, compensate for any unevenness in the surface using metal spacing shims next to each bolt.
4. Check the pump aggregate for any distortion with a straightedge:

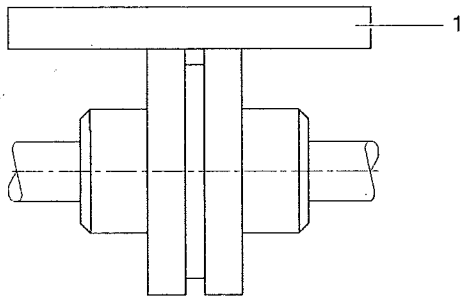



Fig. 10 Checking for distortion

   - Measure in two planes at an angle of 90° on the circumference of the coupling.
   - Check the light gap at the outer diameter using a straightedge (1):
     Position the straightedge across both halves of the coupling.
     If there is a significant deviation, loosen the fixings to the base plate and correct the distortion by inserting more shims.
   - 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.

ℹ Couplings with a spacer piece (dismountable coupling) can also be inspected with a dial gage.

## 5.3 Setup without foundation

✔ Implements, tools and materials:
- Wrench
- Spirit level

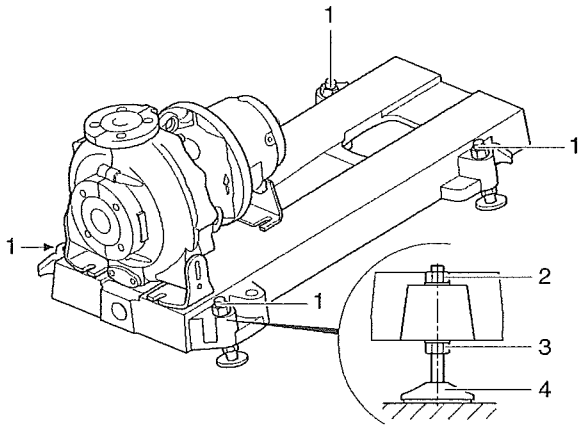



Fig. 11 Setup without foundation (sketch)

1. Lift the pump aggregate (→ 4.1.2 Lifting, Page 12).
2. Fit four leveling feet (1) as illustrated.
3. Set the pump aggregate down on the surface.
4. Use the adjustable feet (1) to set the height of the base plate as illustrated above:
   - Use a wrench to hold the hexagon steady on the leveling foot (4).
   - Loosen the hexagon nut (2).
   - Set the height by turning the hexagon nut (3).
   - Tighten the hexagon nut (2) (→ 9.2.4 Tightening torques, Page 40).
   - Use the integrated spirit levels to check that the pump is level end to end and side to side with max. 1 mm/m allowable tilt.
   - Repeat the procedure until the base plate is correctly aligned.

## 5.4 Installing the motor

ⓘ Only necessary if the pump aggregate is assembled on site.

**CAUTION**

**Material damage caused by knocks and bumps!**

▶ Keep the coupling halves properly aligned when pushing on the motor.

▶ Do not knock or hit any components of the pump.

1. Smear a very thin coat of molybdenum disulfide (e.g. Molykote) on the shaft ends of the pump and motor.
2. Insert shaft keys.
3. Without a mounting rig: remove the rubber buffers and warm up both halves of the coupling to approx. 100 °C.
4. Slide on the pump-side and motor-side coupling halves until the shaft ends are flush with the center of the coupling. When doing this, ensure the prescribed spacing between the two halves of the coupling is maintained (→ assembly instructions for the coupling).
5. Tighten the grub screws on both halves of the coupling.
6. Use suitable metal shims under the motor to align the end of the motor shaft to the end of the pump shaft.
7. Fit the motor bolts, but do not tighten them yet (→ 5.9 Aligning the motor, Page 20).

## 5.5 Planning the piping

### 5.5.1 Specifying supports and flange connections

**CAUTION**

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

▶ Do not exceed the permissible limits (→ 9.2.9 Flange loads according to ISO 5199, Page 43).

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

### 5.5.2 Specifying nominal diameters

ⓘ Keep the flow resistance in the pipes as low as possible.

1. Specify the nominal suction pipe diameter ≥ nominal suction flange diameter.
2. Specify the nominal pressure pipe diameter ≥ nominal pressure flange diameter.

### 5.5.3 Specifying pipe lengths

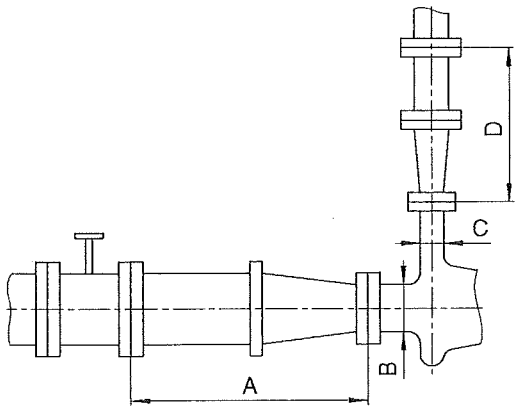



Fig. 12 Straight pipe lengths upstream and downstream of the pump (recommended)

A > 5 x nominal suction pipe diameter
B Nominal suction pipe diameter
C Nominal pressure pipe diameter
D > 5 x nominal pressure pipe diameter

▶ Maintain the recommended minimum values when installing the pump.

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

Pressure side: shorter pipes are possible but can result in increased operating noise.

### 5.5.4 Optimizing cross-section and direction changes

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

### 5.5.5 Provide safety and control devices (recommended)

**Avoid impurities**

1. Integrate a filter into the suction pipe.
2. To monitor impurities, install a differential pressure gauge with a contact manometer.

**Avoid reverse running**

▶ Install a non-return valve between the pressure flange and the gate valve to ensure the medium does not flow back when the pump is switched off.

**Make provisions for isolating and shutting off the pipes**

ⓘ For maintenance and repair work.

▶ Provide shut-off devices in the suction and pressure pipes.

**Allow the measurement of the operating conditions**

1. Provide manometers for pressure measurements in suction and pressure pipes.
2. Provide for motor-side torque measurements.
3. Provide for pump-side temperature measurements.

## 5.6 Connecting the pipes

### 5.6.1 Keeping the piping clean

**CAUTION**

**Material damage due to impurities in the pump!**

▶ Make sure no impurities can get into the pump.

1. Clean all piping parts and armatures prior to assembly.
2. Ensure no flange seals protrude inwards.
3. Remove any blind flanges, plugs, protective foils and/or protective paint from flanges.

### 5.6.2 Installing auxiliary pipes (if available)

ⓘ Follow the manufacturers' specifications for any existing auxiliary systems.

1. Connect the auxiliary pipes to the auxiliary connections so that they are stress-free and do not leak (→ setup drawing).
2. To avoid air pockets, run the pipes with a continuous slope up to the pump.

### 5.6.3 Installing the suction pipe

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.

### 5.6.4 Installing the pressure pipe

1. Remove the transport and sealing covers from the pump.
2. Install the pressure pipe.
3. Ensure no seals protrude inwards.

### 5.6.5 Inspection for stress-free pipe connections

✔ Piping installed and cooled down

1. Separate 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:
   - Nominal diameter < 150 mm: by hand
   - Nominal diameter > 150 mm: with small lever
3. Make sure the flange surfaces are parallel.
4. Reconnect the pipe connecting flanges to the pump.

### 5.6.6 Checking the support foot for distortion (if available)

1. Loosen the bolts connecting the support foot to the base plate.
2. If the support foot moves, compensate for distortion:
   - Lateral shift: by means of slotted holes
   - Height shift: by means of metal shims
3. Screw the support foot back onto the base plate, making sure that the bearing bracket is not distorted in the process.

## 5.7 Electrical connection

**⚠ 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 in that state when carrying out any fitting or maintenance work.

### 5.7.1 Connecting the motor

ℹ Follow the instructions of the motor manufacturer.

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

### 5.7.2 Checking the direction of rotation

**⚠ DANGER**

**Risk of death due to rotating parts!**

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

▶ Secure the shaft key from being thrown out when checking the direction of rotation.

▶ Keep an adequate distance to rotating parts.

**CAUTION**

**Material damage caused by running dry or wrong direction of rotation!**

▶ Uncouple the motor from the pump.

1. Switch the motor on and immediately off again.
2. Check whether the direction of rotation of the motor corresponds to the rotational direction arrow on the pump.
3. If the direction of rotation is different: swap two phases.
4. Couple the motor to the pump again.

## 5.8 Aligning the coupling precisely

**⚠ DANGER**

**Risk of death due to rotating parts!**

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

**CAUTION**

**Material damage due to incorrect alignment of the coupling!**

- ▶ If there is any height, lateral or angular misalignment, align the motor exactly with the pump.
- ▶ For detailed information and special couplings: (→ manufacturer's specifications).

**Checking the alignment of the coupling**

✔ Implements, tools and materials:
- Feeler gage
- Straightedge
- Dial gage (can be used for couplings with a spacer piece)
- Other suitable tools, e.g. laser alignment instrument

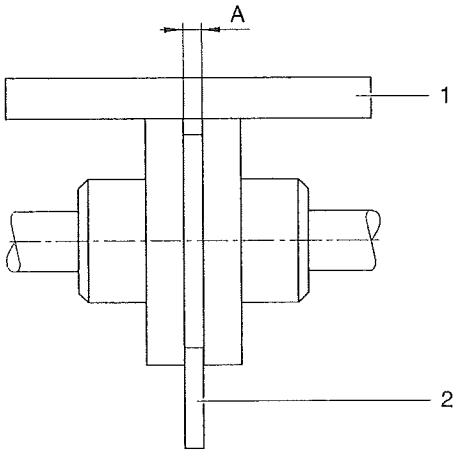



Fig. 13 Checking the alignment of the coupling

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 with a straightedge (1):
   - Position the straightedge across both halves of the coupling.
   - If there is a visible gap at the outer diameter, align the motor (→ 5.9 Aligning the motor, Page 20).
3. Measuring the gap with a feeler gage (2):
   - Permissible gap (→ setup drawing).
   - Use the feeler gage to measure the gap (A) between the halves of the coupling.
   - If the gap exceeds the permissible range, align the motor (→ 5.9 Aligning the motor, Page 20).

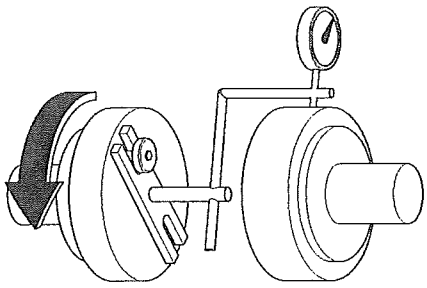


Fig. 14 Inspecting for lateral and vertical misalignment

4. Check for any lateral or vertical misalignment using the dial gage:
   - Carry out the measurement as illustrated.
   - If there is any lateral or vertical misalignment, align the motor (→ 5.9 Aligning the motor, Page 20).
     Permissible axial or radial deviation, measured on the coupling front or coupling circumference, respectively: < 0.05 mm

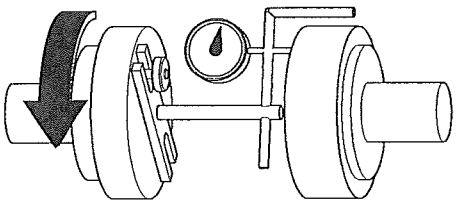


Fig. 15 Checking the angular displacement

5. Check the angular displacement with a dial gage:
   - Carry out the measurement as illustrated.
   - If there is any angular misalignment: align the motor.

## 5.9 Aligning the motor

Alignment options:
- With sets of shims
- With adjusting screws

### 5.9.1 Aligning the motor with sets of shims

1. Align the motor so that the halves of the coupling are exactly flush with each other, fitting 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.

### 5.9.2 Aligning the motor with adjusting screws

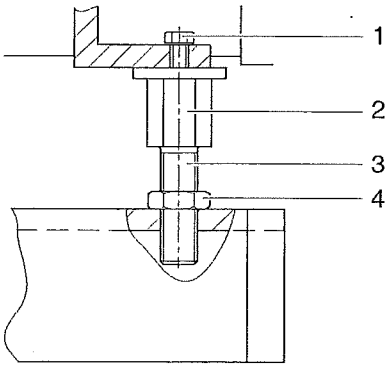



Fig. 16 Aligning the motor with adjusting screws

Observe the angle of rotation of the spindle when adjusting the adjusting screws (→ 9.2.8 Height offset for motor alignment with adjusting screw, Page 42).

1. Determine the necessary angle of rotation of the wrench for the height offset measured (→ 9.2.8 Height offset for motor alignment with adjusting screw, Page 42).
2. Loosen the hexagon head bolts (1).
3. Carry out the following steps on all adjusting screws (3):
   - Hold the adjusting screw (3) firmly on the hexagon head (2) and loosen the lock nut (4).
   - Turn the adjusting screw (3) to the selected angle.
   - Hold the adjusting screw (3) firmly on the hexagon head (2) and tighten the lock nut (4).
4. Tighten the hexagon head bolts (1).
5. Check the alignment.
6. Repeat the alignment procedure if there is still any vertical misalignment.
7. Then tighten the motor bolts.

# 6 Operation

For pumps in explosion hazard areas (→ ATEX additional instructions).

## 6.1 Preparations for the initial start-up

### 6.1.1 Identifying the pump type

▶ Identify the pump type (→ order data sheet).

Pump types vary e.g. with regard to bearing lubrication, bearing bracket size, type of shaft seal and auxiliary systems.

### 6.1.2 Removing the preservative

Only necessary for pumps treated with preservative

▶ (→ 4.4 Removing the preservative , Page 13).

### 6.1.3 Lubricating the bearings

Pumps with grease-lubricated roller bearings are ready for operation upon delivery.

### 6.1.4 Preparing auxiliary systems (if available)

The manufacturer does not accept any liability for damage arising from the installation or use of a third-party or unapproved auxiliary system.

**Sealing systems**

1. Verify that the sealing medium is suitable to mix (i.e. compatible) with the pumped medium.
2. Identify the sealing system:
   - (→ Order data sheet)
   - (→ 3.4.1 Sealing systems, Page 11).
3. Install the sealing system (→ manufacturer's specifications).
4. Make sure the parameters required for the installed sealing system are met (→ 9.2.2 Parameters for auxiliary systems, Page 39).

### 6.1.5 Filling and bleeding

✔ Auxiliary systems ready for operation

**⚠ WARNING**

**Risk of injury and poisoning due to hazardous pumped media!**

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

**CAUTION**

**Material damage caused by dry running!**

▶ Make sure the pump is filled properly.

1. Fill the pump and the suction pipe with pumped medium.
2. Open the suction-side armature.
3. Open the pressure-side armature.
4. If available: open the auxiliary systems and check the flow rate.
5. Verify that no pipe connections are leaking.

## 6.2 Start-up

### 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 existing auxiliary systems are ready for operation
✔ All safety equipment installed and tested for functionality
✔ Pump prepared, filled and bled properly

**⚠ 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 caused by pumped medium spraying out!**

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

**CAUTION**

**Material damage caused by dry running!**

- ▶ Make sure the pump is filled properly.

**CAUTION**

**Risk of cavitation when throttling down the suction flow rate!**

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

**CAUTION**

**Material damage caused by overheating!**

- ▶ Do not operate the pump while the pressure-side armature is closed.
- ▶ Observe the minimum flow rate (→ order data sheet).

1. Open the suction-side armature.
2. Close the pressure-side armature.
3. Switch on the motor and check it for smooth running.
4. Once the motor has reached its nominal speed, slowly open the pressure-side armature until the operating point is reached.
5. For pumps with hot pumped media, make sure any temperature changes do not exceed 50 °C/h.
6. After the initial stress caused by pressure and operating temperature, check that the pump is not leaking.
7. If the pumped media is hot, switch off the pump briefly at operating temperature, check the alignment of the coupling and realign the motor if necessary (→ 5.8 Aligning the coupling precisely, Page 19).
8. If present, set a slight leak on the packing gland.

### 6.2.2 Switching off

✔ Pressure-side armature closed (recommended)

**⚠ WARNING**

**Risk of injury due to hot pump parts!**

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

1. Switch off the motor.
2. Check all connecting bolts and tighten them if necessary.

## 6.3 Shutting down

**⚠ WARNING**

**Risk of injury and poisoning due to hazardous pumped media!**

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

▶ Take the following measures whenever the pump is shut down:

| Pump is | Measure |
|---|---|
| ...shut down for a prolonged period | ▶ Take any measures depending on the pumped medium (→ Table 8 Measures depending on the behavior of the pumped medium, Page 23). |
| ...emptied | ▶ Close the suction-side and pressure-side armatures. |
| ...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 13). |

Tab. 7 Measures to be taken if the pump is shut down

| Behavior of pumped medium | Duration of shutdown (depending on process) | |
|---|---|---|
| | Short | Long |
| Solids sediment | ▶ Flush the pump. | ▶ Flush the pump. |
| Solidifies/ freezes, non-corrosive | ▶ Heat up or empty the pump and containers. | ▶ Empty the pump and containers. |
| Solidifies/ freezes, corrosive | ▶ Heat up or empty the pump and containers. | ▶ Empty the pump and containers.<br>▶ Treat the pump and containers with preservative. |
| Remains liquid, non-corrosive | – | – |
| Remains liquid, corrosive | – | ▶ Empty the pump and containers.<br>▶ Treat the pump and containers with preservative. |

Tab. 8 Measures depending on the behavior of the pumped medium

## 6.4 Start-up following a shutdown period

1. If the pump is shut down for > 1 year, take the following measures before starting it up again:

| Shutdown period | Measure |
|---|---|
| > 1 year | ▶ For versions with roller bearings without lifetime lubrication: relubricate |
| > 2 years | ▶ Replace elastomer seals (O-rings, shaft sealing rings).<br>▶ Replace antifriction bearings. |

Tab. 9 Measures to be taken after prolonged shutdown periods

2. Carry out all steps as for the initial start-up (→ 6.2 Start-up, Page 22).

## 6.5 Operating the stand-by pump

✔ Stand-by pump filled and bled

ⓘ Operate the stand-by pump at least once a week.

1. Completely open the suction-side armature.
2. Open the pressure-side armature to an extent that the stand-by pump reaches its operating temperature and is heated through evenly (→ 6.2.1 Switching on, Page 22).

# 7 Maintenance

For pumps in explosion hazard areas (→ ATEX additional instructions).

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

## 7.1 Inspections

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

**⚠ 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 media!**

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

1. Check at appropriate intervals:
   - Maintenance of minimum flow rate
   - Temperature of roller bearings < 120 °C
   - Normal operating conditions unchanged
   - Coupling alignment and condition of elastic parts
2. For trouble-free operation, always ensure the following:
   - No dry running
   - No leaks
   - No cavitation
   - Suction-side gate valves open
   - Unobstructed and clean filters
   - Sufficient supply pressure
   - No unusual running noises or vibrations
   - No excessive leakage at the shaft seal
   - Proper functioning of auxiliary systems
   - Put the installed stand-by pump into operation at least once a week

## 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 actual operating conditions. Therefore, general statements regarding their service life cannot be made.

**⚠ 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 in that state 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 media!**

- ▶ Use 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 unpressurized.
- ▶ Empty the pump, safely collect the pumped medium and dispose of the medium in accordance with environmental rules and requirements.

### 7.2.1 Antifriction bearings lubricated with grease

- ▶ As a precaution, replace antifriction bearings with lifetime lubrication every 2 years (recommended).

### 7.2.2 Mechanical seals

Due to their function, mechanical seals always leak a bit (→ manufacturer's specifications).

Single mechanical seals with quenching: any drastic rise in the level of the quenching system indicates a major leak at the product-side mechanical seal.

- ▶ In the event of a larger leak: replace the mechanical seal and its auxiliary seals and check the integrity of the auxiliary systems.

### 7.2.3 Packing gland

The packing gland must always leak slightly to carry the frictional heat away.

Larger leaks in the initial hours of operation lessen during the running-in period.

▶ If there is increased leakage: gently tighten the hexagon nuts on the gland.

## 7.3 Dismounting

**⚠ 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 in that state 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 media!**

▶ Use 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 unpressurized.

▶ Empty the pump, safely collect the pumped medium and dispose of the medium in accordance with environmental rules and requirements.

### 7.3.1 Returning the pump to the manufacturer

✔ Pump unpressurized

✔ Pump completely empty

✔ Electrical connections isolated and motor secured against switch-on

✔ Pump cooled down

✔ Coupling guard dismounted

✔ With couplings with a spacer piece: spacer piece removed

✔ Auxiliary systems shut down, unpressurized and emptied

✔ Manometer connections, manometer and fixtures dismounted

1. Always enclose a truthfully (fully) completed safety certificate when returning pumps or individual parts to the manufacturer (→ 9.4 Document of compliance, Page 46).
2. Take necessary measures, depending on the required repair work, as listed in the table below when returning the pump to the manufacturer.

| Repair carried out | 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 to pump hazardous media.<br>▶ Return the complete pump (not disassembled) to the manufacturer. |
| ...at the manufacturer's premises for warranty repairs | ▶ Only if the pumped media is hazardous: flush and decontaminate the pump.<br>▶ Return the complete pump (not disassembled) to the manufacturer. |

Tab. 10 Measures for return

### 7.3.2 Preparations for dismounting

- ✔ Pump unpressurized
- ✔ Pump completely empty, flushed and decontaminated
- ✔ Electrical connections isolated and motor secured against switch-on
- ✔ Pump cooled down
- ✔ Coupling guard dismounted
- ✔ With couplings with a spacer piece: spacer piece removed
- ✔ Auxiliary systems shut down, unpressurized and emptied
- ✔ Manometer connections, manometer and fixtures dismounted

In production, the pumps are constructed to a standard process. The slide-in unit can be removed without removing the volute casing and piping.

If a coupling with a spacer piece is used, the motor can remain mounted on the base plate.

▶ When dismounting, observe the following:
- Precisely mark the assembly orientation and position of all components before dismounting.
- Dismantle components concentrically without canting.
- Dismount the pump (→ sectional drawing).

## 7.4 Installing

Reinstall the components concentrically, without canting, following the markings made.

1. When installing, observe the following:
   - Replace worn parts with genuine spare parts.
   - Replace seals, inserting them so that they cannot rotate.
   - Maintain the specified tightening torques (→ 9.2.4 Tightening torques, Page 40).
2. Clean all parts (→ 9.2.5 Cleaning agents, Page 40). Do not remove the prepared markings.
3. Install the pump (→ sectional drawing).
4. Replace the antifriction bearings.
5. If available, fill any open antifriction bearings without guard disks with grease:
   - Make sure you use the correct type and minimum amount of grease when filling the bearing (→ 9.2.6 Lubricants, Page 40).
   - Fill the cavities between the rolling elements up to 40 % with grease.
   - Wipe off any excess grease with a soft object.
6. Install the pump in the system (→ 5 Setup and connection, Page 14).

## 7.5 Ordering spare parts

For trouble-free replacement in the event of any faults, we recommend keeping complete slide-in units or spare pumps available on site.

The application guidelines conforming to DIN 24296 recommend provisioning for two years of continuous use (→ 9.3 Spare parts for two years of continuous operation according to DIN 24296, Page 45).

▶ Have the following information ready to hand when ordering spare parts (→ type plate):
- Pump type
- Pump number
- Year of manufacture
- Part number
- Designation
- Quantity

# 8 Troubleshooting

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

Possible faults are identified by a fault number in the table below. This number identifies the respective cause and remedy in the troubleshooting list.

| Fault | Number |
|---|---|
| Pump not pumping | 1 |
| Pumping rate insufficient | 2 |
| Pumping rate excessive | 3 |
| Pumping pressure insufficient | 4 |
| Pumping pressure excessive | 5 |
| Pump running roughly | 6 |
| Antifriction bearing temperatures too high | 7 |
| Pump leaking | 8 |
| Motor power uptake excessive | 9 |

Tab. 11 Fault number assignment

| Fault number | | | | | | | | | Cause | Remedy |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| X | – | – | – | – | – | – | – | – | Supply/suction pipe and/or pressure pipe closed by armature | ▶ Open the armature. |
| – | X | – | X | – | – | – | – | – | Supply/suction pipe not fully opened | ▶ Open the armature. |
| X | X | – | X | – | X | – | – | – | Supply/suction pipe, pump or suction screen blocked or encrusted | ▶ Clean the supply/suction pipe, pump or suction screen. |
| – | X | – | X | – | X | – | – | – | Supply/suction pipe cross-section too narrow | ▶ Increase the cross-section.<br>▶ Remove any encrustations from the suction pipe.<br>▶ Open the armature completely. |
| X | – | – | – | – | – | – | – | – | Transport and sealing cover still in place | ▶ Remove the transport and sealing cover.<br>▶ Dismount the pump and inspect it for dry-running damage. |
| – | X | – | X | – | X | – | – | – | Differential head excessive: $NPSH_{pump}$ larger than $NPSH_{system}$ | ▶ Increase the supply pressure.<br>▶ Consult the manufacturer. |
| X | – | – | – | – | X | – | – | – | Supply/suction pipe not bled properly or not filled up completely | ▶ Fill up the pump and/or piping completely and bleed them. |
| X | – | – | – | – | X | – | – | – | Supply/suction pipe contains air pockets | ▶ Install the armature for bleeding.<br>▶ Correct the piping layout. |
| X | X | – | X | – | X | – | – | – | Air is sucked in | ▶ Seal the source of malfunction. |
| X | X | – | X | – | X | – | – | – | Excessive amount of gas: pump is cavitating | ▶ Consult the manufacturer. |
| – | X | – | X | – | X | – | – | – | Pumped medium temperature too high: pump is cavitating | ▶ Increase the supply pressure.<br>▶ Lower the temperature.<br>▶ Consult the manufacturer. |

| Fault number | | | | | | | | | Cause | Remedy |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| – | X | – | X | – | – | – | – | X | Viscosity or specific gravity of the pumped medium outside the range specified for the pump | ▶ Consult the manufacturer. |
| – | X | – | X | – | – | – | – | – | Geodetic differential head and/or pipe flow resistances too high | ▶ Remove sediments from the pump and/or pressure pipe.<br>▶ Install a larger impeller and consult the manufacturer. |
| – | X | – | – | X | X | – | – | – | Pressure-side armature not opened sufficiently | ▶ Open the pressure-side armature. |
| X | X | – | – | X | X | – | – | – | Pressure pipe blocked | ▶ Clean the pressure pipe. |
| X | X | – | X | – | X | – | – | – | Pump running in the wrong direction | ▶ Swap any two phases on the motor. |
| X | X | – | X | – | – | – | – | – | Motor speed insufficient | ▶ Compare the required motor speed with the specifications on the pump type plate. Replace the motor if necessary.<br>▶ Increase the motor speed if speed control is available. |
| – | X | – | X | – | X | X | – | – | Pump parts worn | ▶ Replace the worn pump parts. |
| – | – | X | X | – | X | – | – | X | Pressure-side armature opened too wide | ▶ Throttle down at the pressure-side armature.<br>▶ Machine the impeller down. Consult the manufacturer and adjust the impeller diameter. |
| – | – | X | – | – | X | – | – | X | Geodetic differential head, pipe flow resistances and/or other resistances lower than specified | ▶ Throttle down the flow rate at the pressure-side armature. Observe the minimum flow rate.<br>▶ Machine the impeller down. Consult the manufacturer and adjust the impeller diameter. |
| – | – | X | – | X | – | – | – | – | Viscosity lower than expected | ▶ Machine the impeller down. Consult the manufacturer and adjust the impeller diameter. |
| – | – | X | – | X | X | X | – | X | Motor speed too high | ▶ Compare the required motor speed with the specifications on the pump type plate. Replace the motor if necessary.<br>▶ Reduce the motor speed if speed control is available. |
| – | – | X | – | X | X | – | – | X | Impeller diameter too large | ▶ Throttle down the flow rate at the pressure-side armature. Observe the minimum flow rate.<br>▶ Machine the impeller down. Consult the manufacturer and adjust the impeller diameter. |
| X | X | – | X | – | X | – | – | – | Impeller out of balance or blocked | ▶ Dismount the pump and inspect it for dry-running damage.<br>▶ Clean the impeller. |
| – | X | – | X | – | X | – | – | – | Hydraulic parts of the pump dirty, clotted or encrusted | ▶ Dismount the pump.<br>▶ Clean the parts. |

| Fault number | | | | | | | | | Cause | Remedy |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| – | – | – | – | – | X | X | – | X | Defective antifriction bearing in bearing bracket | ▶ Replace the antifriction bearing. |
| – | – | – | – | – | – | X | – | X | Defective antifriction bearing in motor | ▶ Replace the antifriction bearing. |
| – | – | – | – | – | – | X | – | – | Lubricant: too much, not enough or unsuitable | ▶ Reduce, top up or replace the lubricant. |
| – | – | – | – | – | – | – | X | – | Connecting bolts not tightened correctly | ▶ Tighten the connecting bolts. |
| – | – | – | – | – | – | – | X | – | Mechanical seal worn | ▶ Replace the mechanical seal. |
| – | – | – | – | – | – | – | X | – | Housing seal defective | ▶ Replace the housing seal. |
| – | – | – | – | – | – | – | X | – | Shaft sleeve is penetrated | ▶ Replace the shaft sleeve and/or O-ring. |
| – | – | – | – | – | X | X | X | X | Pump distorted | ▶ Check the pipe connections and pump fixings.<br>▶ Check the coupling alignment.<br>▶ Check the fixing of the support foot. |
| – | – | – | – | – | X | X | – | – | Coupling not properly aligned | ▶ Align the coupling. |
| – | – | – | – | – | X | – | – | – | Coupling units worn | ▶ Replace the coupling units and realign them. |
| – | X | – | X | – | X | – | – | X | Motor running on 2 phases | ▶ Check the fuse and replace it if necessary.<br>▶ Check the cable connections and insulation. |

Tab. 12 Troubleshooting list

# 9 Appendix

## 9.1 Sectional drawings

### 9.1.1 Auxiliary connections

| Abbreviation | Connection |
|---|---|
| FD, FD1 | Pumped medium / emptying |
| FF | Filling |
| FV, FV1 | Filling / Bleeding |
| PM1 | Pressure gauge |
| PM2 | Pressure gauge |
| LO | Leak / egress |

Tab. 13 Abbreviations of the connection designations

### 9.1.2 Part numbers and designations

| Part no. | Designation |
|---|---|
| 102.01 | Volute casing |
| 108.01 | Stage casing |
| 161.01 | Housing cover |
| 161.03 | Housing cover |
| 161.05 | Housing cover |
| 161.10 | Housing cover |
| 161.12 | Housing cover |
| 162.01 | Suction cover |
| 171.01 | Diffuser |
| 181.01 | Pump frame |
| 182.01 | Foot |
| 183.01 | Support foot |
| 183.10 | Support foot |
| 210.01 | Shaft |
| 210.02 | Shaft |
| 230.01 | Impeller |
| 230.02 | Impeller, first stage |
| 230.03 | Impeller, second stage |
| 321.01 | Radial ball bearing |
| 321.02 | Radial ball bearing |
| 321.03 | Radial ball bearing |
| 321.04 | Radial ball bearing |
| 322.01 | Cylindrical roller bearing |
| 330.01 | Bearing bracket |
| 360.01 | Bearing cover |
| 360.02 | Bearing cover |
| 400.01 | Gasket |
| 400.02 | Gasket |
| 411.01 | Seal ring |
| 411.02 | Seal ring |
| 411.03 | Seal ring |
| 411.04 | Seal ring |
| 411.05 | Seal ring |
| 411.06 | Seal ring |
| 411.37 | Seal ring |
| 412.01 | O-ring |
| 412.06 | O-ring |
| 412.07 | O-ring |
| 412.10 | O-ring |
| 424.01 | V-ring |
| 424.02 | V-ring |
| 433.01 | Mechanical seal |
| 441.01 | Shaft seal housing |
| 452.01 | Gland |
| 458.01 | Lantern ring |
| 461.01 | Gland packing |
| 502.01 | Split ring |
| 502.02 | Split ring |
| 507.01 | Oil thrower |
| 509.01 | Intermediate ring |
| 514.01 | Threaded ring |
| 516.01 | Nilos ring |
| 516.02 | Nilos ring |
| 523.01 | Shaft sleeve |
| 523.02 | Shaft sleeve |
| 525.01 | Spacer sleeve |
| 531.01 | Clamping sleeve |
| 551.01 | Spacer disk |
| 551.10 | Spacer disk |
| 551.12 | Spacer disk |
| 557.01 | Balance disk |
| 565.01 | Rivet |

| Part no. | Designation |
|---|---|
| 592.10 | Base |
| 672.01 | Vent |
| 730.01 | Pipe connection |
| 901.03 | Hexagon head bolt |
| 901.04 | Hexagon head bolt |
| 901.05 | Hexagon head bolt |
| 901.10 | Hexagon head bolt |
| 901.11 | Hexagon head bolt |
| 901.12 | Hexagon head bolt |
| 901.13 | Hexagon head bolt |
| 902.01 | Stud bolt |
| 902.03 | Stud bolt |
| 902.05 | Stud bolt |
| 902.06 | Stud bolt |
| 903.01 | Screw plug |
| 903.02 | Screw plug |
| 903.03 | Screw plug |
| 903.04 | Screw plug |
| 903.05 | Screw plug |
| 903.06 | Screw plug |
| 903.26 | Screw plug |
| 904.01 | Grub screw |
| 904.05 | Grub screw |
| 908.01 | Jacking screw |
| 908.02 | Jacking screw |
| 908.03 | Jacking screw |
| 914.01 | Cheese head screw |
| 914.02 | Cheese head screw |
| 914.03 | Cheese head screw |
| 914.04 | Cheese head screw |
| 914.05 | Cheese head screw |
| 914.07 | Cheese head screw |
| 914.10 | Cheese head screw |
| 920.01 | Hexagon nut |
| 920.03 | Hexagon nut |
| 920.05 | Hexagon nut |
| 920.06 | Hexagon nut |
| 922.01 | Impeller nut |
| 932.01 | Circlip |
| 932.04 | Circlip |
| 932.10 | Circlip |
| 934.01 | Spring washer |
| 936.01 | Spring ring |
| 940.01 | Shaft key |
| 940.02 | Shaft key |
| 940.03 | Shaft key |
| 951.01 | Cup spring |
| 971.01 | Name plate |

Tab. 14 Designations of components according to part numbers

### 9.1.3 Sectional drawings

**Sizes at bearing bracket 228**

With sizes 20-160, 25-200 and 2/25-200, filling option at PM2 connection. FF connection not available.

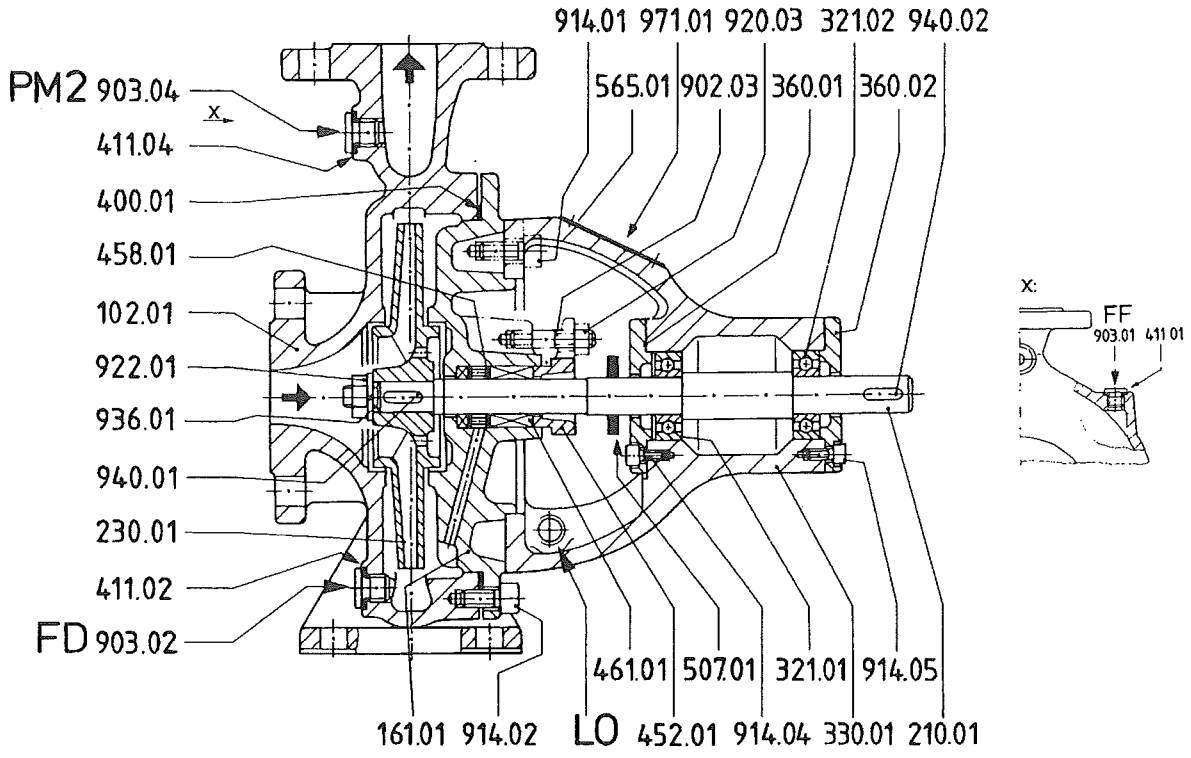



Fig. 17 **U1B** – Packing gland with self-locking

Sizes at bearing bracket 360, two-stage

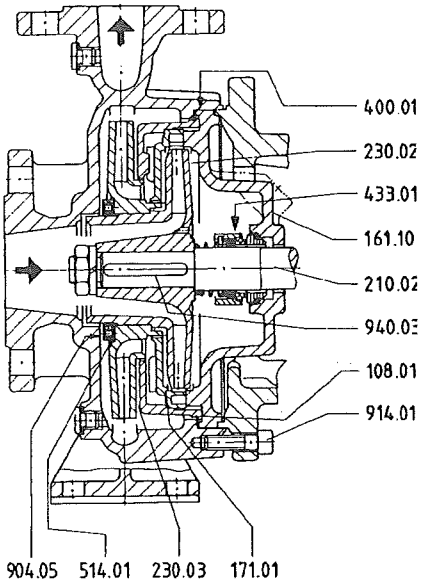



Fig. 18 **U3...D** – Unbalanced mechanical seal

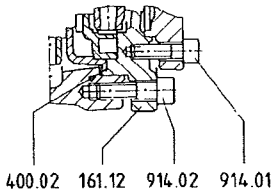



Fig. 19 Housing cover version for sizes 2/40-250 and 2/50-250

**Sizes at bearing brackets 360, 470 and 530**

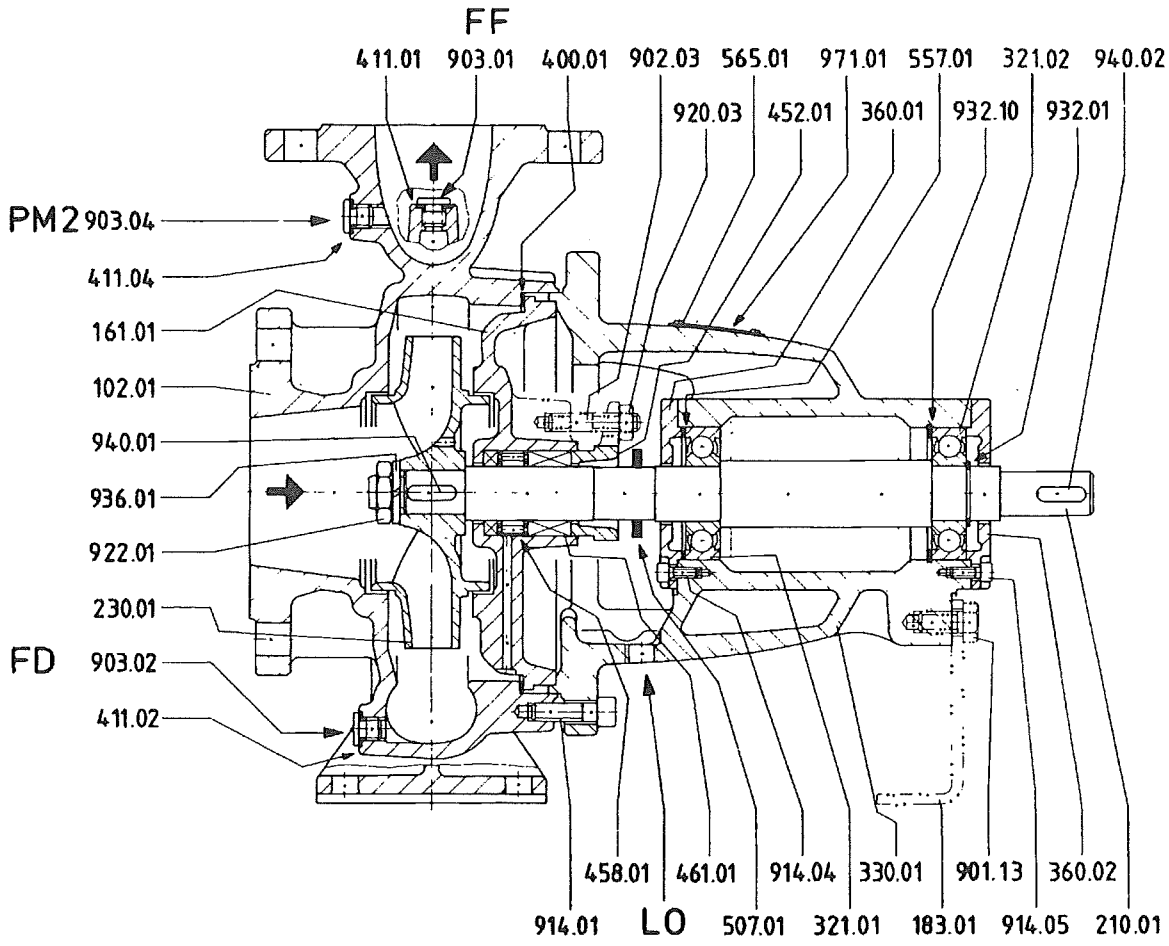



Fig. 20 **U1B** – Packing gland with self-locking

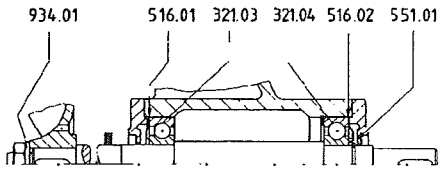



Fig. 21 Bearing bracket size 530 version

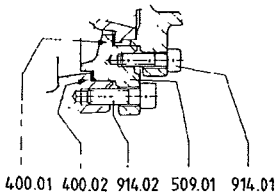



Fig. 22 Version with intermediate ring

**Sizes at bearing bracket 585**

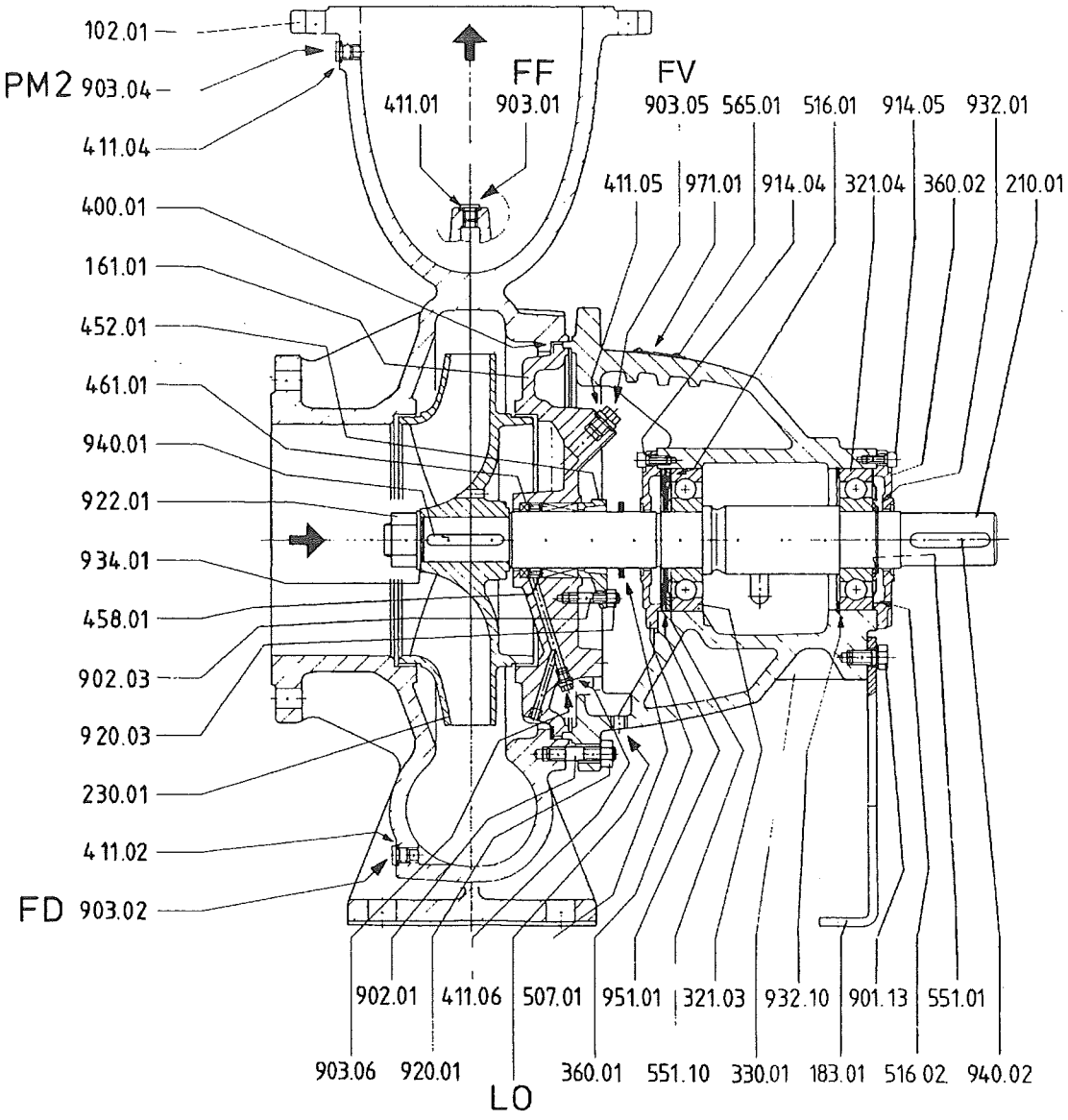



Fig. 23 **U1B** – Packing gland with self-locking

### Sizes 300–315 and 300–400 at bearing bracket 585

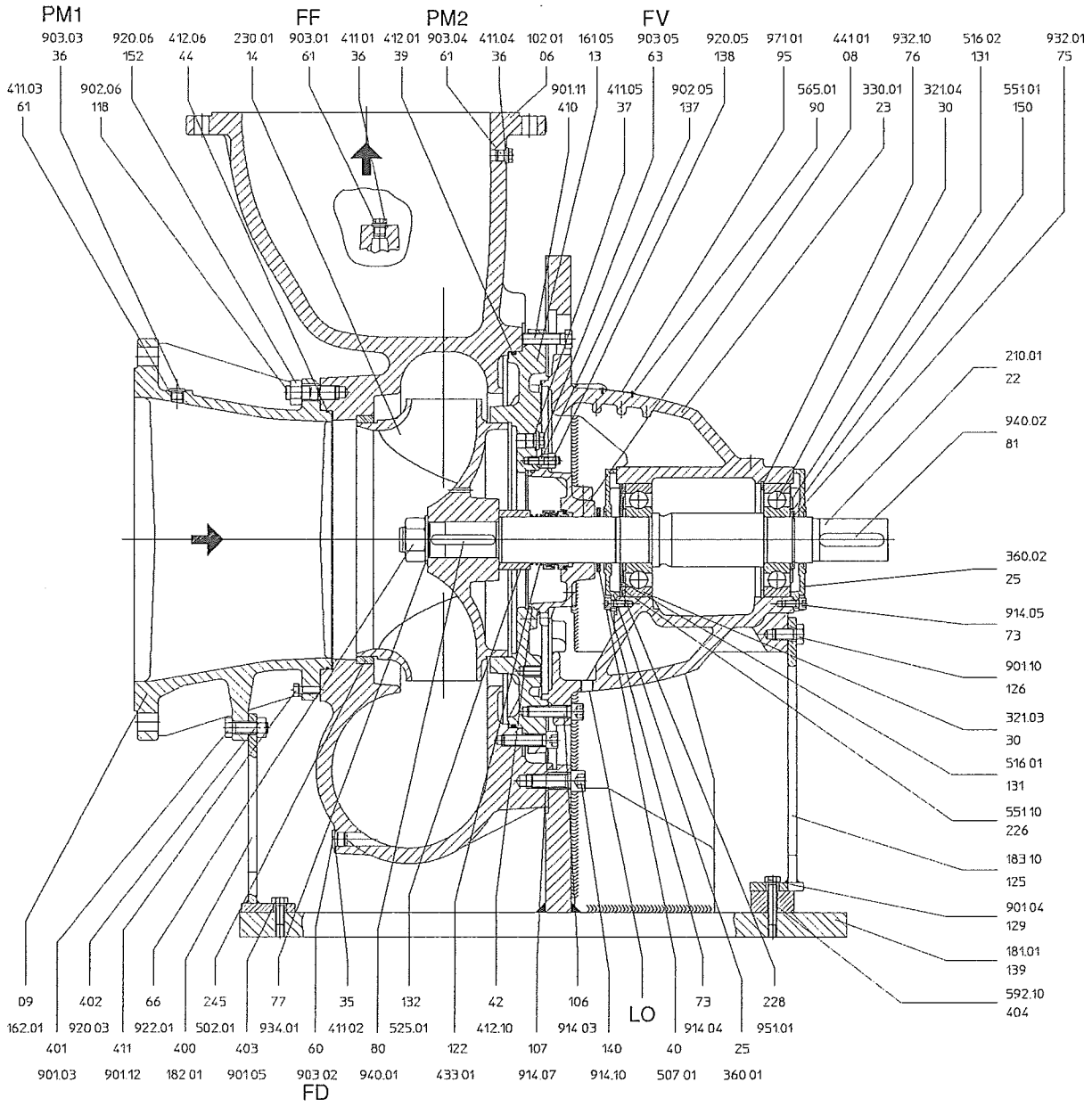



Fig. 24 **U3...D** – Unbalanced mechanical seal

## Sizes 300–315 and 300–400 at bearing bracket 700

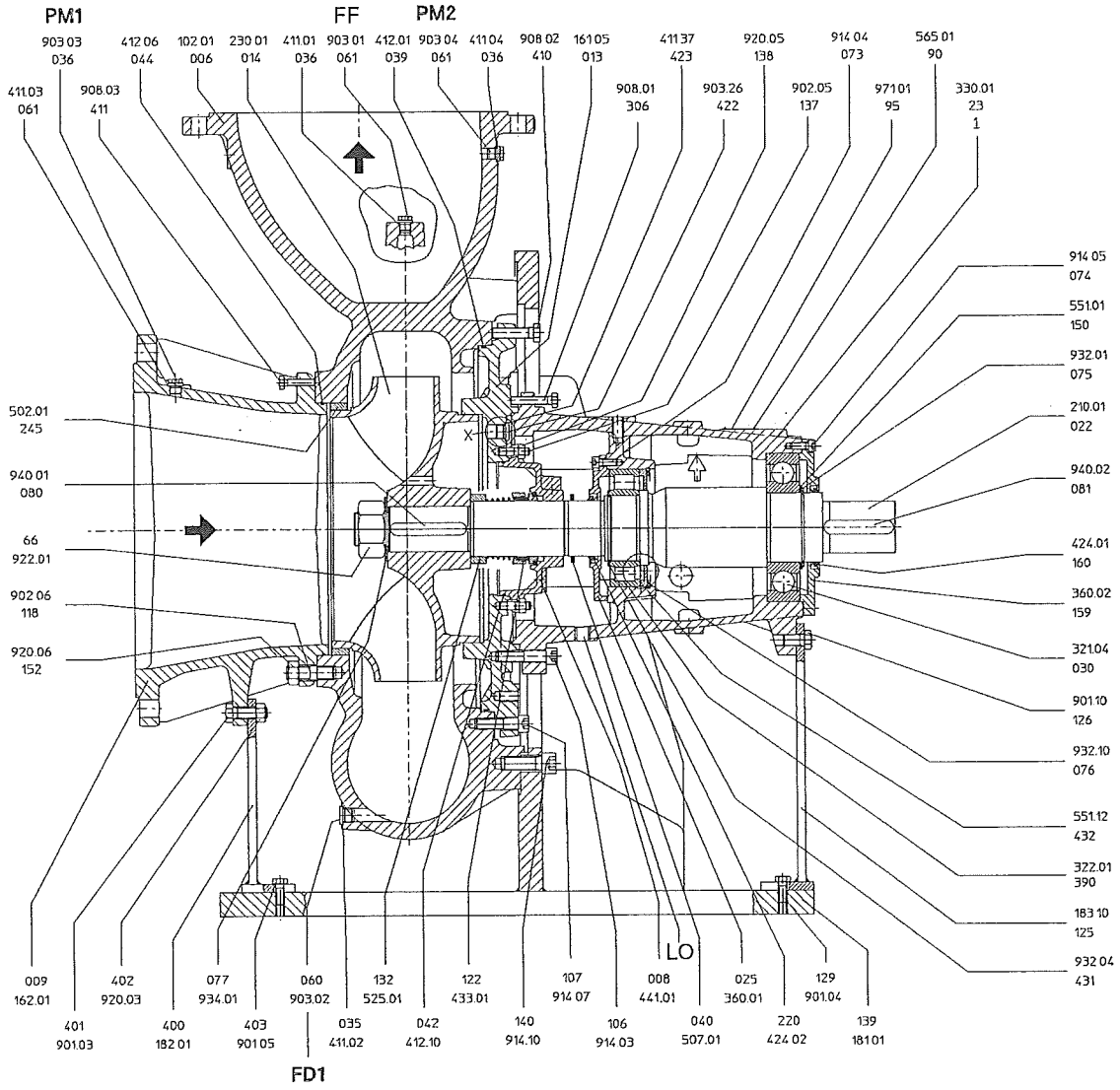
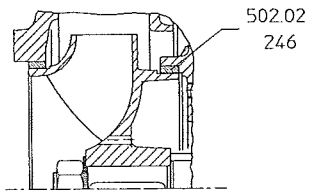
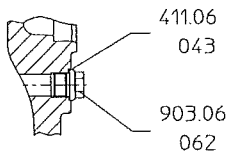
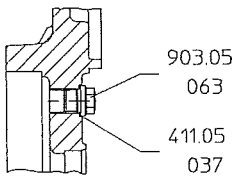



Fig. 25 **U3...D** – Unbalanced mechanical seal

| Version with V2 split ring | C01 connection on volute casing | X housing cover detail |
|---|---|---|
|   |   |   |

Tab. 15 Versions and details at bearing bracket 700

### 9.1.4 Seals

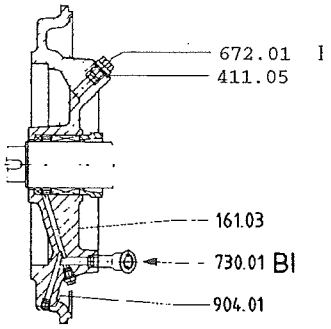



Fig. 26 **U1C** – Packing gland with external flushing

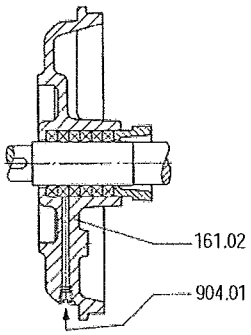



Fig. 30 **U1A** – Packing gland without blocking

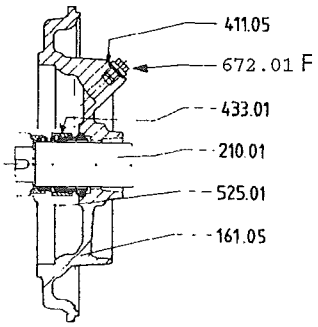



Fig. 27 **U3...D** – Unbalanced mechanical seal

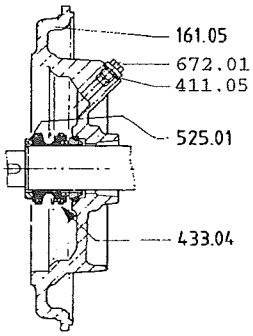



Fig. 28 **U3.9D, U3.12D** – Unbalanced mechanical seal

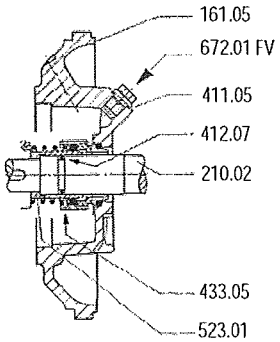



Fig. 29 **U2...D** – Balanced mechanical seal

## 9.2 Technical specifications

More technical specifications (→ order data sheet).

### 9.2.1 Ambient conditions

Operation under other ambient conditions to be agreed with the manufacturer

| Temperature [°C] | Relative humidity [%] | | Setup height above sea level [m] |
|---|---|---|---|
| | Long-term | Short-term | |
| –20 to +40 | ≤ 85 | ≤ 100 | ≤ 1000 |

Tab. 16 Ambient conditions

### 9.2.2 Parameters for auxiliary systems

**Sealing medium in open flow system**

| Sealing medium for | Volume [l/h] | Pressure |
|---|---|---|
| Quenching | 150 | Unpressurized |

Tab. 17 Operating parameter for sealing medium in open flow system

### 9.2.3 Sound pressure levels

Measuring conditions:

- Distance to the pump: 1 m
- Operation: cavitation-free
- Motor: IEC standard motor
- Tolerance ±3 dB

Lower-noise versions of the motors are available if the expected noise levels exceed the permissible limits.

| Nominal motor power PM [kW] | Sound pressure level [dB] for pump with motor at speed [$min^{-1}$] | | | |
|---|---|---|---|---|
| | 1450 | 1750 | 2900 | 3500 |
| 1.5 | 58 | 58.5 | 63 | 64 |
| 2.2 | 60 | 60.5 | 66 | 67 |
| 3.0 | 62 | 62.5 | 68 | 69 |
| 4.0 | 63 | 63.5 | 69 | 70 |
| 5.5 | 65 | 65.5 | 71 | 72 |
| 7.5 | 66 | 66.5 | 72 | 73 |
| 11.0 | 68 | 68.5 | 74 | 75 |
| 15.0 | 69 | 69.5 | 75 | 76 |
| 18.5 | 70 | 70.5 | 76 | 77 |
| 22.0 | 71 | 71.5 | 77 | 78 |
| 30.0 | 72 | 72.5 | 78 | 79 |
| 37.0 | 73 | 73.5 | 79 | 80 |
| 45.0 | 74 | 74.5 | 80 | 81 |
| 55.0 | 75 | 75.5 | 80 | 81 |
| 75.0 | 76 | 76.5 | 81 | 82 |
| 90.0 | 76 | 76.5 | 82 | 83 |
| 110.0 | 77 | 77.5 | 82 | 83 |
| 132.0 | 78 | 78.5 | 83 | 84 |
| 160.0 | 79 | 79.5 | 84 | 85 |
| 200.0 | 80 | 80.5 | 85 | 86 |

Tab. 18 Sound pressure levels

### 9.2.4 Tightening torques

| Part no. | Thread gage | Quality | Tightening torque [Nm] |
|---|---|---|---|
| 901.03 | M16 | 8.8 | 150 |
| 901.04<br>901.05 | M12 | 5.6 | 35 |
| 901.10 | M16 | 8.8 | 150 |
| 901.13 | M12<br>M16 | 8.8 | 31<br>150 |
| 902.01 | M16 | 8.8 | 150 |
| 902.05 | M12 | A4–70 | 44 |
| 902.06 | M20 | A4–70 | 204 |
| 903.01<br>903.02<br>903.03<br>903.04<br>903.05<br>903.06<br>903.26 | G 1/4<br>G 3/8<br>G 1/2 | St | 10<br>15<br>30 |
| 914.01 | M8<br>M10<br>M12<br>M16 | 8.8 | 19<br>35<br>63<br>150 |
| 914.02 | M12 | 8.8 | 63 |
| 914.04<br>914.05 | M6<br>M8<br>M10 | 8.8 | 9<br>22<br>35 |
| 914.07 | M16 | 8.8 | 150 |
| 914.10 | M20 | 8.8 | 300 |
| 920.01<br>920.03 [1)]<br>920.05<br>920.06 | M16<br>M16<br>M12<br>M20 | 5<br>5<br>A4–70<br>A4–70 | 80<br>80<br>44<br>204 |
| 922.01 | M12 x 1.5<br>M20 x 1.5<br>M24 x 1.5<br>M30 x 1.5<br>M36 x 1.5<br>M48 x 1.5 | 1.4021 | 20<br>96<br>157<br>279<br>565<br>700 |

Tab. 19 Tightening torques

1) does not apply to size 300–315 and 300–400 NT pumps

### 9.2.5 Cleaning agents

| Application area | Cleaning agents |
|---|---|
| Foodstuffs and drinking water sector | E.g. spirit, Ritzol 155, strong alkaline soapy solution, steam jet (for individual parts only) |
| Other | Benzine, wax solvents, diesel, paraffin, alkaline cleaners |

Tab. 20 Cleaning agents

### 9.2.6 Lubricants

| Manufacturer | Brand name | Name according to DIN 51825 |
|---|---|---|
| Agip | Agip GR MU3 | K3K–20 |
| ARAL | Aralub HL3 | K3K–20 |
| BP | BP Energrease LS3 | K3K–20 |
| ESSO | BEACON 3 | K3K–20 |
| Fuchs | RENOLIT FWA 220 | K3K–20 |
| Klüber | MICROLUBE GL 263 | K3K–20 |
| Mobil-Öl | Mobilux 3 | K3K–20 |
| Shell | Shell Alvania Fett R3 | K3K–20 |
| SKF | SKF-Fett LGMT3 | K3K–20 |

Tab. 21 Grease types

| Size of the bearing bracket | Short designation of the antifriction bearing | Approx. amount of grease [g] |
|---|---|---|
| 530 | 6410 J C3 | 35 |
| 585 | 6413 J C3 | 65 |
| 700 | NU 2219 ECJ | 50 |

Tab. 22 Minimum amounts for grease lubrication

### 9.2.7 Preservatives

Use Valvoline preservatives or similar (recommended).

| Type of storage | Storage duration [months] | Preservative inside/ outside | Renew [months] inside/ outside |
|---|---|---|---|
| In closed, dry and dust-free room | 6–12 | Tectyl 511 M | – |
| | > 12 | Tectyl 506 EH | 48/48 |
| In open air, central European climate | 6–12 | Tectyl 542 | – |
| | > 12 | Tectyl 506 EH | 48/18 |
| In open air, tropical climate, aggressive industrial atmosphere or close to sea | 6–12 | Tectyl 542/ Tectyl 506 EH | – |
| | > 12 | Tectyl 506 EH | 48/12 |

Tab. 23 Valvoline preservatives

### 9.2.8 Height offset for motor alignment with adjusting screw

| Height adjustment [mm] | Rotation angle of spindle [°] | Setting aid |
|---|---|---|
| 0.02 | 5 | – |
| 0.04 | 10 | – |
| 0.06 | 15 | – |
| 0.08 | 20 | – |
| 0.10 | 25 | – |
| 0.13 | 30 | Shaft key surface to point of hexagon |
| 0.15 | 35 | – |
| 0.17 | 40 | – |
| 0.19 | 45 | – |
| 0.21 | 50 | – |
| 0.23 | 55 | – |
| 0.25 | 60 | Shaft key surface to shaft key surface |
| 0.27 | 65 | – |
| 0.29 | 70 | – |
| 0.31 | 75 | – |
| 0.33 | 80 | – |
| 0.35 | 85 | – |
| 0.38 | 90 | 1/4 turn |
| 0.40 | 95 | – |
| 0.42 | 100 | – |
| 0.44 | 105 | – |
| 0.46 | 110 | – |
| 0.48 | 115 | – |
| 0.50 | 120 | – |
| 0.52 | 125 | – |
| 0.54 | 130 | – |
| 0.56 | 135 | – |
| 0.58 | 140 | – |
| 0.60 | 145 | – |
| 0.63 | 150 | – |
| 0.65 | 155 | – |
| 0.67 | 160 | – |
| 0.69 | 165 | – |
| 0.71 | 170 | – |
| 0.73 | 175 | – |
| 0.75 | 180 | 1/2 turn |
| 0.77 | 185 | – |
| 0.79 | 190 | – |
| 0.81 | 195 | – |
| 0.83 | 200 | – |
| 0.85 | 205 | – |
| 0.88 | 210 | – |
| 0.90 | 215 | – |
| 0.92 | 220 | – |
| 0.94 | 225 | – |
| 0.96 | 230 | – |
| 0.98 | 235 | – |
| 1.00 | 240 | – |
| 1.02 | 245 | – |
| 1.04 | 250 | – |
| 1.06 | 255 | – |
| 1.08 | 260 | – |
| 1.10 | 265 | – |
| 1.13 | 270 | 3/4 turn |
| 1.15 | 275 | – |
| 1.17 | 280 | – |
| 1.19 | 285 | – |
| 1.21 | 290 | – |
| 1.23 | 295 | – |
| 1.25 | 300 | – |
| 1.27 | 305 | – |
| 1.29 | 310 | – |
| 1.31 | 315 | – |
| 1.33 | 320 | – |
| 1.35 | 325 | – |
| 1.38 | 330 | – |
| 1.40 | 335 | – |
| 1.42 | 340 | – |
| 1.44 | 345 | – |
| 1.46 | 350 | – |
| 1.48 | 355 | – |
| 1.50 | 360 | 1 full turn |

Tab. 24 Height setting at the adjusting screw

### 9.2.9 Flange loads according to ISO 5199

**Empirical formulas for forces and torques**

$$\sum|F_{vS}| = \sum|F_{zS}|$$
$$\sum|F_{hS}| = \sum|F_{xS}| + \sum|F_{yS}|$$
$$\sum|F_{vD}| = \sum|F_{zD}|$$
$$\sum|F_{hD}| = \sum|F_{xD}| + \sum|F_{yD}|$$
$$\sum|M_{tD}| = \sum|M_{xD}| + \sum|M_{yD}| + \sum|M_{zD}|$$
$$\sum|M_{tS}| = \sum|M_{xS}| + \sum|M_{yS}| + \sum|M_{zS}|$$

Fig. 31 Empirical formulas for forces and torques

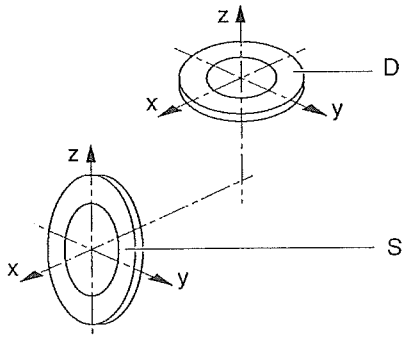



Fig. 32 Flange loads at the pump

**Formulas for conditions to be checked**

For pumps
- With support foot
- Without support foot and with coupling for high permissible shaft offset

$$\sum|M_t| = \sum\left(|M_{tS}| + |M_{tD}|\right) \le M_{t\,max}$$
$$\sum|F_h| = \sum\left(|F_{hS}| + |F_{hD}|\right) \le F_{h\,max}$$
$$\sum|F_v| = \sum\left(|F_{vS}| + \frac{2}{3}|F_{vD}|\right) \le F_{v\,max}$$
$$\left(\frac{\sum|F_v|}{F_{v\,max}}\right)^2 + \left(\frac{\sum|F_h|}{F_{h\,max}}\right)^2 + \left(\frac{\sum|M_t|}{M_{t\,max}}\right)^2 \le 1$$

For pumps without support foot

$$\sum|M_t| = \sum|M_x| + 3\times\sum|M_y| + \sum|M_z| \le M_{t\,max}$$
$$\sum|F_h| = \sum|F_{xS}| + 2{,}5\times\sum|F_{xD}| + \sum|F_y| \le F_{h\,max}$$
$$\sum|F_v| = \sum\left(|F_{vS}| + \frac{2}{3}|F_{vD}|\right) \le F_{v\,max}$$
$$\left(\frac{\sum|F_v|}{F_{v\,max}}\right)^2 + \left(\frac{\sum|F_h|}{F_{h\,max}}\right)^2 + \left(\frac{\sum|M_t|}{M_{t\,max}}\right)^2 \le 1$$

To calculate the maximum permissible flange load: multiply the table value with the correction factor M, depending on the material and temperature (→ Figure Correction factor M and operating temperature, Page 44).

| Pump size | Values for base plate | | | | | |
|---|---|---|---|---|---|---|
| | Not filled with concrete | | | Filled with concrete | | |
| | $F_{v\,max}$ (z) [N] | $F_{h\,max}$ (x, y) [N] | $M_{t\,max}$ [Nm] | $F_{v\,max}$ (z) [N] | $F_{h\,max}$ (x, y) [N] | $M_{t\,max}$ [Nm] |
| 20–160 | 1300 | 1000 | 200 | 3000 | 1400 | 270 |
| 25–160 | 2000 | 1400 | 400 | 4500 | 3100 | 850 |
| 25–200 | 1900 | 1400 | 350 | 4400 | 2900 | 800 |
| 32–160 | 2300 | 1600 | 500 | 4600 | 3200 | 1000 |
| 32–200 | 2100 | 1500 | 450 | 4500 | 3100 | 900 |
| 32–250 | 2500 | 1700 | 550 | 4800 | 3450 | 1100 |
| 40–160 | 2700 | 1800 | 650 | 5000 | 3600 | 1250 |
| 40–200 | 2400 | 1700 | 550 | 4800 | 3400 | 1100 |
| 40–250 | 2800 | 1900 | 700 | 5200 | 3800 | 1350 |
| 40–315 | 2900 | 2000 | 700 | 5300 | 3850 | 1400 |
| 50–160 | 3200 | 2100 | 800 | 5500 | 4100 | 1650 |
| 50–200 | 2800 | 1900 | 700 | 5200 | 3800 | 1350 |
| 50–250 | 3200 | 2200 | 850 | 5600 | 4250 | 1650 |
| 50–315 | 3300 | 2200 | 850 | 5700 | 4300 | 1700 |
| 65–160 | 4200 | 2800 | 1200 | 6700 | 5200 | 2400 |
| 65–200 | 4500 | 2900 | 1300 | 7000 | 5500 | 2600 |
| 65–250 | 4000 | 2600 | 1100 | 6400 | 5000 | 2250 |
| 65–315 | 4700 | 3100 | 1400 | 7300 | 5800 | 2850 |
| 65–400 | 3200 | 2200 | 850 | 5600 | 4100 | 1600 |
| 80–160 | 5300 | 3400 | 1650 | 8000 | 6400 | 3350 |
| 80–200 | 5600 | 3600 | 1700 | 8300 | 6700 | 3600 |
| 80–250 | 4900 | 3200 | 1400 | 7500 | 5900 | 3000 |

| Pump size | Values for base plate | | | | | |
|---|---|---|---|---|---|---|
| | Not filled with concrete | | | Filled with concrete | | |
| | $F_{v\,max}$ (z) [N] | $F_{h\,max}$ (x, y) [N] | $M_{t\,max}$ [Nm] | $F_{v\,max}$ (z) [N] | $F_{h\,max}$ (x, y) [N] | $M_{t\,max}$ [Nm] |
| 80–315 | 5900 | 3800 | 1850 | 8800 | 7100 | 3900 |
| 80–400 | 5400 | 3500 | 1650 | 8100 | 6500 | 3400 |
| 100–160 | 5000 | 3200 | 1500 | 7600 | 6000 | 3050 |
| 100–200 | 7000 | 4400 | 2300 | 10300 | 8700 | 5000 |
| 100–250 | 7900 | 5000 | 2700 | 11600 | 10300 | 6000 |
| 100–315 | 7200 | 4600 | 2400 | 10600 | 9100 | 5250 |
| 100–400 | 7200 | 4600 | 2350 | 10500 | 9000 | 5200 |
| 125–200 | 7300 | 4600 | 2400 | 10900 | 9500 | 5200 |
| 125–250 | 9700 | 6100 | 3450 | 14000 | 12800 | 7300 |
| 125–315 | 8500 | 5400 | 2950 | 12500 | 11400 | 6700 |
| 125–400 | 8600 | 5400 | 2950 | 12700 | 11600 | 6850 |
| 150–200 | 12600 | 8000 | 4800 | 17700 | 16600 | 9600 |
| 150–250 | 12800 | 8000 | 4850 | 17800 | 16700 | 9700 |
| 150–315 | 13200 | 8300 | 5050 | 18400 | 17300 | 10100 |
| 150–400 | 11400 | 7200 | 4200 | 16200 | 15000 | 8700 |
| 150–500 | 12100 | 7600 | 4550 | 17000 | 15900 | 9200 |
| 200–250 | 16600 | 10600 | 6600 | 22400 | 21400 | 12600 |
| 200–315 | 17500 | 11200 | 7000 | 23400 | 22400 | 13200 |
| 200–400 | 16000 | 10100 | 6300 | 21700 | 20700 | 12200 |
| 200–500 | 16700 | 10700 | 6650 | 22500 | 21500 | 12700 |
| 250–315 | 19900 | 13100 | 7350 | 25500 | 24500 | 13900 |
| 250–400 | 19800 | 13100 | 7400 | 25400 | 24400 | 14000 |
| 300-315 | 27750 | 18700 | 11000 | 37000 | 34000 | 20000 |
| 300-400 | 27750 | 18700 | 11000 | 37000 | 34000 | 20000 |

Tab. 25 Flange loads

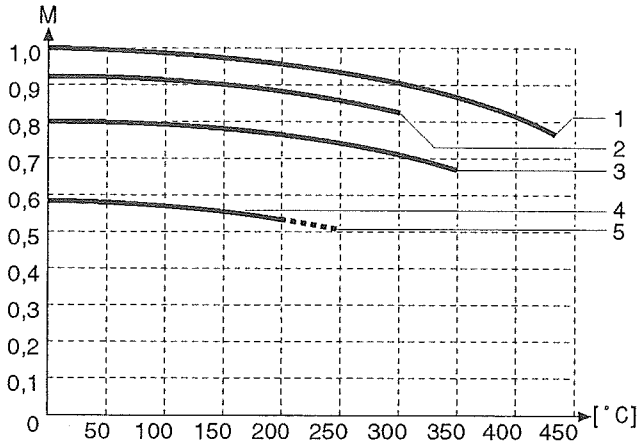



Fig. 33 Correction factor M and operating temperature

1 Non-alloyed steel cast
2 Austenitic steel cast
3 Spheroidal iron EN-GJS-400
4 Gray cast iron EN-GJL-200
5 Bronze G-CuAl10Ni

## 9.3 Spare parts for two years of continuous operation according to DIN 24296

| Part no. | Part designation | Number of identical pumps (including stand-by pumps) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2 | 3 | 4 | 5 | 6 or 7 | 8 or 9 | > 9 |
| | | Set/quantity of spare parts | | | | | | |
| 230.01 | Impeller (all single-stage pump sizes) | 1 | 1 | 1 | 2 | 2 | 3 | 30 % |
| 171.01 | Impeller (all two-stage pump sizes) | 1 | 1 | 1 | 2 | 2 | 3 | 30 % |
| 230.02<br>230.03<br>514.01<br>904.05 | Impeller, first stage and<br>Impeller, second stage<br>with 1)<br>Threaded ring and<br>Grub screws | 1 | 1 | 1 | 2 | 2 | 3 | 30 % |
| 210.01<br>922.01<br>934.01<br>936.01 | Shaft<br>Impeller nut 1)<br>Spring washer or<br>Spring ring | 1 | 1 | 2 | 2 | 2 | 3 | 30 % |
| 210.02<br>922.01<br>934.01<br>936.01 | Shaft<br>Impeller nut 1)<br>Spring washer or<br>Spring ring | 1 | 1 | 2 | 2 | 2 | 3 | 30 % |
| 210.03<br>922.01<br>934.01<br>936.01 | Shaft<br>Impeller nut 1)<br>Spring washer or<br>Spring ring | 1 | 1 | 2 | 2 | 2 | 3 | 30 % |
| 321.01<br>321.02<br>321.03<br>321.04<br>322.01 | Groove ball bearing<br>Groove ball bearing<br>Groove ball bearing 2)<br>Groove ball bearing<br>Cylindrical roller bearing | 1 | 1 | 2 | 2 | 3 | 4 | 50 % |
| – 1) | Bearing bracket, complete, consisting of:<br>Shaft, bearing, bearing cover etc. | – | – | – | – | – | 1 | 2 |
| 433... | Mechanical seal | 2 | 3 | 4 | 5 | 6 | 7 | 90 % |
| 461.01 | Gland packing rings (set) | 4 | 4 | 6 | 6 | 6 | 8 | 40 % |
| 502.01<br>502.02 | Split ring<br>Split ring | 2 | 2 | 2 | 3 | 3 | 4 | 50 % |
| Various[1)] | Seals for pump housing (set)<br>Other seals (set) | 4 | 6 | 8 | 8 | 9 | 12 | 150 % |

Tab. 26 Spare parts for two years of continuous operation

1) Delivered as a mechanical unit (BG) or sales unit (VG)

2) Depending on the size of the bearing bracket

## 9.4 Document of compliance

# Document of compliance

The pump, together with additional equipment, we (as signed person) sent for inspection or repair,

Type: _____ Delivery date: _____

Item-no.: _____ Order-no.: _____

Reason for the inspection / repair oder: _____

_____

☐ have never been used for harmful / environmentally hazardous substances.

☐ have been used for application of _____

and have been in contact with fluids for which a liability of labeling occur, or which have toxic ingredients.

Last fluid which has been pumped: _____

☐ The pump has been carefully drained, as well as cleaned inside and outside before shipping / allocation.

☐ Specific safety arrangements are not necessary for further handling.

☐ Following safety arrangements concerning flushing medium, fluid left over and waste disposal are necessary:

_____

_____

! If any critical medium has been inside the pump please necessarily enclose a **safety data sheet** to

We confirm, that the made statements are correct and complete, and that the shipment will be made due to legal requirements.

Company / Address: _____ Phone: _____

_____ Fax: _____

_____

Customer-no.: ☐☐☐☐☐☐☐

Name of drawer: (in block letters) | Position:

_____ _____

**Date** **Company stamp / Signature**