Original Operating Manual

SKT Volute-Casing Centrifugal Pump

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Contents

1 GENERAL 6
1.1 About this operating manual 6
1.2 Target groups 6
1.3 Other valid documents 6
1.4 Warning notices and symbols 7
1.5 Copyright/changes 7
2 SAFETY 8
2.1 Correct and proper use 8
2.2 General safety instructions 8
2.2.1 Product safety 9
2.2.2 Duties of the system owner 9
2.2.3 Duties of personnel 10
2.3 Dangers of non-observance of the safety instructions 10
2.4 Unauthorized conversion and production of spare parts 11
2.5 Unauthorized modes of operation 11
2.6 Special hazards 11
2.6.1 Explosion area 11
2.6.2 Hazardous pumping media 11
2.6.3 Noise emissions 11
3 LAYOUT AND FUNCTION 12
3.1 Labeling 12
3.2 Scope of delivery, type SKT centrifugal pump 12
3.3 General information 12
3.4 Technical data 12
4 TRANSPORT AND INTERMEDIATE STORAGE 14
4.1 Transport 14
4.1.1 Unpacking and checking the delivery condition 14
4.1.2 Lifting 14
4.2 Intermediate storage 14
4.3 Storage 15
4.4 Disposal 16
5 ASSEMBLY AND INSTALLATION 17
5.1 Preparing for installation 17
5.1.1 Preparing the installation location 17
5.1.2 Preparing the base surface and foundations 17
5.1.3 Removing the preservative 18
5.2 Installation 19

5.2.1 Installing the pump ... 19
5.2.2 Securing the pump unit ... 20
5.2.3 Assembling the motor ... 21
5.3 Fine alignment of the coupling ... 21
5.3.1 Horizontal configuration ... 22
5.3.2 Vertical configuration ... 23
5.4 Aligning the motor ... 23
5.4.1 Aligning the motor with shims ... 24
5.4.2 Aligning the motor with adjustment screws ... 24
5.5 Planning pipelines ... 24
5.5.1 General ... 24
5.5.2 Avoiding contaminations in the pipelines ... 26
5.5.3 Configuring supports and flange connections ... 26
5.5.4 Determining nominal widths ... 27
5.5.5 Determining pipeline lengths ... 27
5.5.6 Optimizing changes in cross-section and direction ... 27
5.5.7 Providing safety and monitoring systems (recommended) ... 27
5.6 Attaching the pipelines ... 28
5.6.1 Installing auxiliary pipelines ... 28
5.6.2 Installing the suction pipe ... 28
5.6.3 Installing the pressure pipe ... 28
5.6.4 Checking for lack of tension in the pipeline connection ... 28
5.7 Electrical connection ... 29
5.7.1 Connecting the motor ... 30
6 COMMISSIONING/DECOMMISSIONING ... 31
6.1 Commissioning ... 31
6.1.1 Determining the pump configuration ... 31
6.1.2 Filling the pump ... 31
6.1.3 Checking direction of rotation ... 32
6.1.4 Starting the pump ... 33
6.2 Decommissioning ... 34
6.2.1 Switching off the pump ... 36
6.2.2 Draining the pump and protecting against frost ... 36
6.3 Recommissioning ... 36
6.4 Operating the stand-by pump ... 36
6.5 Shaft seal ... 37
6.5.1 Mechanical seal ... 37
6.5.2 Gland packing ... 37
7 MAINTENANCE AND REPAIR ... 38
7.1 General information ... 38

7.2 Operational monitoring 39
7.3 Maintenance 40
7.3.1 Anti-friction bearings and grease lubrication 40
7.3.2 Servicing the electric motors 41
7.3.3 Servicing the mechanical seals 41
7.3.4 Servicing the gland packing 41
7.4 Sending the pump to the manufacturer 42
7.5 Disassembling the pump 43
7.6 Ordering spare parts 44
8 FAULTS AND TROUBLESHOOTING 45
9 APPENDIX 48
9.1 Spare parts list for constant operation over two years as per DIN 24296 48
9.2 SKT volute-casing centrifugal pump cross-section diagram 49
9.3 Characteristic curves for SKT centrifugal pumps 51
9.4 Declaration of Conformity as per EC Directive 2006/42/EC, Annex IIA 52
9.5 Clearance Certificate 53

List of Tables

Table 1: Target groups and their tasks 6
Table 2: Other valid documents and their purposes 6
Table 3: Warning notices and consequences of non-observance 7
Table 4: Symbols and their meanings 7
Table 5: Noise emissions of the SKT 11
Table 6: Settings for the time relay when using three-phase motors with star-delta switch 13
Table 7: Ambient conditions 17
Table 8: Settings for the time relay when using three-phase motors with star-delta switch 30
Table 9: Measures depending on the behavior of the pumping medium 35
Table 10: Measures in the event of operational interruption 35
Table 11: Measures following longer shut down times 36
Table 12: Measures for return 43
Table 13: Fault/number allocation 45
Table 14: Troubleshooting table 47
Table 15: Spare parts for constant operation over two years 48
Table 16: Parts list for SKT volute-casing centrifugal pump 50

List of Images

Figure 1: Model code 12
Figure 2: Motor connection circuit diagram 13
Figure 3: Lifting the pump 14
Figure 4: Mounting material for complete units 19
Figure 5: Mounting material for pump with open shaft end 19
Figure 6: Aligning the base plate 20
Figure 7: Positional alignment of the shafts 22
Figure 8: Directional alignment of the shafts 22
Figure 9: Aligning the motor with adjustment screws 24
Figure 10: Functional and operating elements 25
Figure 11: Recommended straight pipeline lengths upstream and downstream of the pump 27
Figure 12: Filling the pump 31
Figure 13: Draining the pump 36
Figure 14: Disassembling the pump 44
Figure 15: Cross-section diagram of SKT volute-casing centrifugal pump, standard 49
Figure 16: Pump with casing wear rings 49
Figure 17: Pump with mechanical seal 49
Figure 18: Collective characteristic curve for SKT with speed at 1450 rpm 51
Figure 19: Collective characteristic curve for SKT with speed at 2900 rpm 51

1 General

1.1 About this operating manual

This operating manual contains important instructions that must be observed during installation, operation and maintenance. For this reason, ensure that it is read by specialist personnel and the responsible operator/owner prior to assembly and commissioning. The manual must be available at all times at the location where the system is used.

Please observe the safety instructions described in this operating manual, along with the relevant national accident prevention regulations and any internal work, operational and safety specifications of the operator. We assume no liability for damages and operational interruptions resulting from non-observance of this operating manual.

⚠ **WARNING**

Pay particular attention to section 2 "Safety instructions" during commissioning and all maintenance work.

Section 2 also provides an explanation of the symbols used in this manual. Knowledge of this operating manual is essential to preventing errors and ensuring safe and uninterrupted operation.

The operating specification does not take local safety regulations into account. The owner bears full responsibility for compliance with these, including on the part of the assembly personnel used.

This operating manual:

- is part of the pump
- is valid for all type series mentioned
- describes safe and proper use in all phases of operation

1.2 Target groups

Target group	Task
System owner	► Ensure that this manual is available at the location where the system is used, including for later reference. ► Ensure that personnel read and observe this operating manual and the other valid documents, in particular the safety and warning information. ► Observe additional system-related regulations and specifications.
Specialist personnel, assembly staff	► Read, observe and follow this operating manual and the other valid documents, in particular the safety and warning information.

Table 1: Target groups and their tasks

1.3 Other valid documents

Document	Purpose
Installation diagram	Installation dimensions, connection dimensions, etc.
Spare parts list	Ordering spare parts
Clearance certificate	Returning the pump
Declaration of conformity	Conformity with standards, content of the declaration of conformity

Table 2: Other valid documents and their purposes

1.4 Warning notices and symbols

Warning notice	Hazard level	Consequences of non-observance
⚠ **DANGER**	Immediate hazard	Death, severe physical injury
⚠ **WARNING**	Potential hazard	Death, severe physical injury
⚠ **CAUTION**	Potentially dangerous situation	Minor physical injury
NOTICE	Potentially dangerous situation	Material damage

Table 3: Warning notices and consequences of non-observance

Symbol	Meaning
⚠	Safety sign ► Follow all instructions identified with safety signs in order to avoid death or injuries.
►	Instruction
1. , 2. , …	Instruction with multiple steps
✓	Condition
→	Reference
ⓘ	Information, note

Table 4: Symbols and their meanings

1.5 Copyright/changes

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OSNA GmbH reserves the right to change the contents of this documentation without notice.

2 Safety

The manufacturer shall not bear any liability for damages caused as a result of non-observance of this documentation.

2.1 Correct and proper use

- Only use this pump for the purposes of conveying the agreed pumping media.
- Comply with operating limits.
- The water may not contain any abrasive or long-fibered components that may damage the pump materials. Consult the manufacturer if using other media.
- Ensure that the pump is only commissioned with pumping medium and is not operated without it.
- Open the suction-side fitting, and do not use it to control the flow rate.
- To avoid damaging the motor, observe the permitted number of times per hour that the motor can be switched on (→ Manufacturer information).
- Any other use must be agreed with the manufacturer.
- The temperature of the pumping medium must not exceed 90 °C.

Avoiding obvious misuse (examples)

- Observe the operating limits of the pump for temperature, pressure, flow rate and speed.

The main areas of use are:

- Pressure boosting systems, heating systems, hot and cold water circulation, water supply systems, power stations, filtering systems, filling and emptying of tanks, water circulation in pools and sprinkler systems
- Fresh water, drinking water, boiler feed water, process water, sea and brackish water, hot water, condensate and many media without aggressive components that do not chemically corrode the materials used in the pump

Do not operate the pump without water. Dry running can lead to damage to the pump.

⚠ WARNING

Any use that goes beyond the purposes described above shall be considered improper use. OSNA shall bear no liability for any resulting damages. The owner bears full risk for improper use.

2.2 General safety instructions

Please observe the following specifications before performing any activities.

2.2.1 Product safety

This pump is constructed according to the latest state of the art and accepted safety rules. Nevertheless, risks to life and limb for the user or third parties are still possible when using the pump, as are impairments to the pump and other material assets.

- Only use the pump in a technically perfect state and for the intended purpose. Ensure compliance with this operating manual and be aware of the hazards and safety issues during operation.
- Keep this operating manual and all other valid documents in a complete and legible state, and store in a location that is accessible at all times to personnel.
- Do not permit any activity that endangers personnel or uninvolved third parties.
- In the event of a safety-relevant fault, stop the pump immediately and have the fault rectified by responsible personnel.
- In addition to this documentation, ensure compliance with the statutory or other regulations for safety and accident prevention, as well as the relevant standards and specifications of the respective country.
- Do not remove any technical stickers.

2.2.2 Duties of the system owner

Safety-conscious work

Observe the safety specifications detailed in this operating manual, along with the occupational safety regulations and all additional internal safety regulations.

- Only use the pump in a technically perfect state and for the intended purpose. Ensure compliance with this operating manual and be aware of the hazards and safety issues during operation.
- Ensure compliance and monitoring:
  - correct and proper use
  - statutory or other safety and accident prevention regulations
  - safety specifications for handling hazardous substances
- Provide personal protective equipment.
- Do not remove contact protection during operation.
- Prevent any dangers from electrical energy (for details, please refer to the specifications of the VDE and the local energy supplier).
- Switch off the motor during all assembly and maintenance works, and secure against reactivation.
- Only work on the system when the pump is at a standstill.

Personnel qualification

The owner of the system must ensure that the personnel tasked with working on the pump have read and understood this operating manual and all other valid documents before beginning work, in particular information on safety, maintenance and repair.

Work of any kind on the machine may only be performed when it has been completely decommissioned. Reinstall and reactivate all safety mechanisms after work.
Before restarting the machine, ensure that all necessary commissioning steps have been completed (→ 6.1 Commissioning, pg 31).

- Determine responsibilities, tasks and monitoring for personnel.
- Only allow work of any kind to be performed by specialist technical personnel:
  - assembly, maintenance and repair work
  - work on the electrical systems
- Only allow personnel undergoing training to perform work on the pump under the supervision of specialist technical personnel.

Safety mechanisms

- Provide the following safety mechanisms and ensure that they function correctly:
  - for moving components: contact protection for the pump, installed by the customer
  - for potential electrostatic charges: appropriate earthing

Guarantee

- Please consult the manufacturer before carrying out any conversions, repairs or changes during the guarantee period.
- Only use original parts or parts approved by the manufacturer.

2.2.3 Duties of personnel

- Observe the information on the pump and ensure it is legible (e.g. direction of rotation arrow, fluid connection indicators).
- Do not remove the contact protection for moving parts during operation.
- Use personal protective equipment if necessary.
- Only work on the system when the pump is at a standstill.
- Switch off the motor during all assembly and maintenance works, and secure against reactivation.
- Reinstall the safety mechanisms after working on the pump according to specifications.

2.3 Dangers of non-observance of the safety instructions

- Non-observance of the safety instructions can lead to hazards to personnel, the machine and the environment.

- Non-observance of the safety instructions can also lead to the loss of any damage claims.

- In particular, non-observance can lead to the following dangers:
  - failure of important system functions
  - electrical and mechanical hazards to personnel

2.4 Unauthorized conversion and production of spare parts

Conversions or changes to the machine are only permitted following consultation with the manufacturer. Original spare parts and accessories authorized by the manufacturer help ensure safety. The manufacturer bears no liability for the consequences of the use of other parts.

2.5 Unauthorized modes of operation

The operational safety of the machine is only guaranteed when it is used for the intended purpose according to the operating manual (→ 2.1 Correct and proper use, pg 8).
Never exceed the limit values indicated in the technical data (→ Data sheet).

2.6 Special hazards

2.6.1 Explosion area

- Do not use the pump in areas where there is a risk of explosion.

2.6.2 Hazardous pumping media

- Observe the safety regulations for handling hazardous substances (e.g. toxic, hazardous to health).

- Use personal protective equipment when performing work on the pump.

2.6.3 Noise emissions

Drive power in kW	Noise emissions in dB(A)	
	1450 min^{-1}	2900 min^{-1}
< 0.55	< 70	< 70
0.75	< 70	< 70
1.1	< 70	< 70
1.5	< 70	< 70
2.2	< 70	< 70
3.0	< 70	< 70
4.0	< 70	< 70
5.5	< 70	< 70
7.5	76	< 70
11	79	< 70
15	78	< 70
18.5	80	< 70
22	84	< 70
Greater power upon request		

Table 5: Noise emissions of the SKT

3 Layout and function

3.1 Labeling

This operating manual applies to the SKT type series.

Model code:

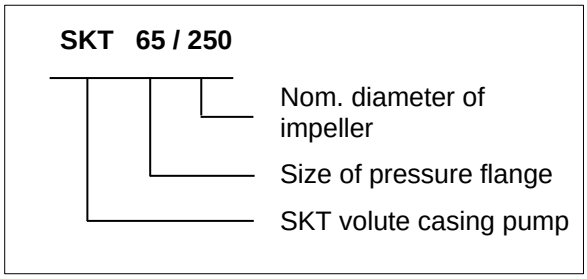

Figure 1: Model code

3.2 Scope of delivery, type SKT centrifugal pump

The customer can order the pump:

- in a preassembled state, i.e. delivery without motor, accessories enclosed unassembled. The motor is installed by the customer.

- in a fully assembled state, i.e. the pump is fitted with motor ex-works.

The scope of delivery corresponds to the scope indicated in the order. Please check that the delivery is complete upon receipt. Notify the delivery company of any transport damage immediately. Please also refer to our conditions of sale and delivery. If using other motor brands, please ensure that the motors have the following drive torques as a multiple of the nominal torque.

3.3 General information

The SKT volute-casing centrifugal pump is a single-stage, non-self-priming centrifugal pump for operation with standard motors and standard mechanical seal.

The nominal flow rate corresponds to the standards of DIN 24255.

The pump flanges are designed in line with DIN 2535.

The impeller is an enclosed radial impeller with dynamic pressure reduction.

The lower pump casing is fitted with a drain screw.

3.4 Technical data

Main pump data:

Suction flange:	DN50 - DN400 PN16 (DIN 2533)
Pressure flange:	DN32 - DN350 PN16 (DIN 2533)
Operating pressure:	10 bar
Test pressure:	15 bar
Flow rate:	5 - 2500 m³/h
Delivery head:	2 - 100 m
Speed:	1000 - 3600 rpm

Main motor data:

ICE squirrel cage motors

Power:	See data sheet
Designation:	IEC 60034-2-1:2007

Frequency:		50 Hz/60 Hz
Thermal class:		155 (F) or better
Protection rating:		IP 54 - IP 55 or better
Vibration severity grade:		Grade A or better
Start:	<= 4 kW:	3x380 V (Y)
	> 4 kW:	3x380 V (Δ + Y/Δ)

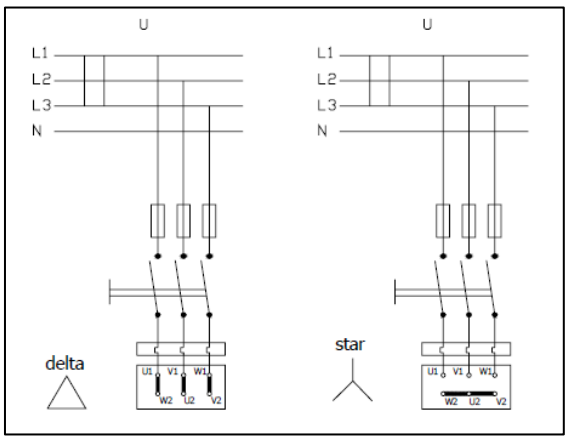

Figure 2: Motor connection circuit diagram

⚠ DANGER

Risk of death from electric shock!

- ► Only allow work on the electrical systems to be carried out by a qualified electrician.
- ► Ensure that the supply of electricity is switched off and secured against reactivation when performing all maintenance work.

Observe the manufacturer information for the motor.

⚠ CAUTION

Material damage when using a three-phase motor with star-delta switch

- ► Adjust the time relay according to the motor power (→ Table 6, pg 13).

Motor power	Time relay setting
≤ 30 kW	3 s 30%
> 30 kW	5 s 30%

Table 6: Settings for the time relay when using three-phase motors with star-delta switch

4 Transport and intermediate storage

4.1 Transport

Weight information (→ Other valid documents)

4.1.1 Unpacking and checking the delivery condition

1. Check that the delivery is complete upon receipt.
2. Unpack the pump/unit upon delivery and check for transport damage.
3. Notify the delivery company of any transport damage immediately.
4. Dispose of the packaging material in line with the applicable local regulations.

4.1.2 Lifting

DANGER

Risk of death or crushed limbs from falling transported goods!

► Choose lifting equipment that is suitable for the total weight to be transported.

► Do not stand under suspended loads.

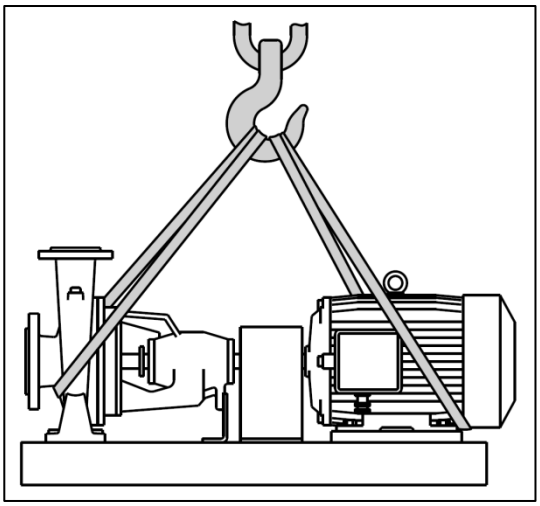

Figure 3: Lifting the pump

4.2 Intermediate storage

Ensure during intermediate storage that the pump is not exposed to any weather conditions for a long period of time. If the pump is decommissioned for a longer period of time (approximately 2 to 3 months), ensure that it is fully drained. (→ 6.2 Decommissioning, pg 34)

4.3 Storage

NOTICE

Material damage due to incorrect storage!

► Ensure that the pump is correctly stored.

1. Close all openings with blank flanges, blind plugs or plastic covers.
2. Ensure that the storage area meets the following conditions:
   – dry
   – free of frost
   – free of vibrations

NOTICE

Damage to bearings from high water pressure or splashing water!

► Do not use water jets or steam jet cleaners to clean the bearing areas.

NOTICE

Damage to seals due to incorrect cleaning agent!

► Ensure that the cleaning agent does not corrode the seals.

1. Choose the cleaning agent according to the area of use.
2. Dispose of preservatives in line with the applicable local regulations.
3. When storing for longer than 6 months:
   – Check all elastomers (round seals, shaft seal rings, gaskets and gland packing) for elasticity, and replace if necessary.

4.4 Disposal

Plastic parts may be contaminated by toxic or radioactive pumping media. If this is the case, cleaning is not sufficient.

⚠ WARNING

Risk of poisoning and environmental damage from pumping medium!

► Use personal protective equipment when performing work on the pump.

► Before disposing of the pump:

- Collect any remaining pumping medium in the pump, and dispose of it in line with the locally valid regulations.
- Neutralize any pumping medium residues in the pump.

► Dispose of the pump in line with the applicable local regulations.

5 Assembly and installation

5.1 Preparing for installation

NOTICE

Material damage due to contamination!

► Only remove covers, transport caps and sealing caps immediately before connecting the pump to the pipelines.

⚠ CAUTION

Ensure compliance with all safety specifications during installation and operation.

1. Ensure that the required ambient conditions are met (→ 5.1.1 Preparing the installation location, pg 17)

2. Please consult the manufacturer when installing at altitudes over 1000 m above mean sea level.

5.1.1 Preparing the installation location

► Ensure that the installation location meets the following conditions:

- pump is freely accessible from all sides
- sufficient space for installing/removing piping, as well as for maintenance and repair work, in particular for installing/removing the pump and motor
- no effects from external vibrations on the pump (bearing damage)
- protection against frost

Temperature [°C]	Relative humidity [%]		Installation altitude above mean sea level [m]
	long term	short term	
-10 to 40	≤ 85	≤ 100	≤ 1000

Table 7: Ambient conditions

5.1.2 Preparing the base surface and foundations

► Ensure that the base surface and foundations meet the following conditions:

- level
- clean (no oils, dust or other contaminations)
- foundations can support the weight of the pump unit and all operating forces
- stability of the pump unit ensured

5.1.3 Removing the preservative

Only necessary for preserved pump.

WARNING

Risk of poisoning from preservatives and cleaning agents in the food and drinking water area!

► Only use cleaning agents that are compatible with the pumping medium.

► Remove the preservative completely.

NOTICE

Damage to bearings from high water pressure or splashing water!

► Do not use water jets or steam jet cleaners to clean the bearing areas.

NOTICE

Damage to seals due to incorrect cleaning agent!

► Ensure that the cleaning agent does not corrode the seals.

1. Choose the cleaning agent according to the area of use.
2. Dispose of preservatives in line with the local regulations.
3. If storing for longer than 6 months:
   - Replace elastomers made from EPDM.
   - Check all elastomers (round seals, shaft seals) for proper elasticity and replace if necessary.

5.2 Installation

5.2.1 Installing the pump

Prior to installation, remove the packaging (if present) and check the pump for any transport damage. Ensure that the installation area is dry and free of frost.

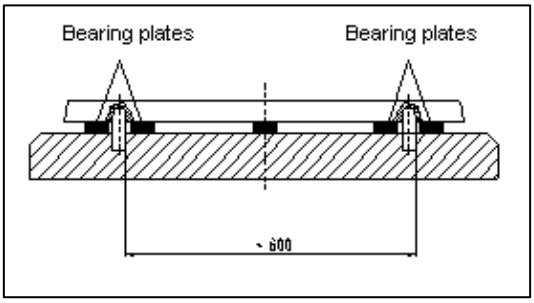

Figure 4: Mounting material for complete units

⚠ CAUTION

Do not operate the pump in areas where there is a risk of explosion. Ensure that the pump is installed and connected in line with the local regulations.

We recommend installing the pump on a noise-insulating base, in order to prevent transmission noises to parts of the building.

Provide an outlet for leakage fluid during maintenance work.

During installation, align the entire unit on the foundation using a spirit level (on shaft/discharge nozzle). Maintain the distance between the coupling halves according to the installation plan. Always insert bearing plates on the left and right side next to the mounting material between the base plate/base frame and the foundation. Provide additional bearing plates if the distance between the mounting materials is greater than 800 mm. Ensure that all bearing plates sit solidly. Base plates with a width greater than 400 mm must be filled out after mounting with a vibration-dampening mortar up to the upper edge of the frame.

If the pump and motor are delivered separately, place the pump onto the foundation without the motor, align using a precision spirit level and secure. For alignment purposes, always insert bearing plates on the left and right side next to the mounting material between the pump base and the foundation. Ensure that all bearing plates sit solidly.

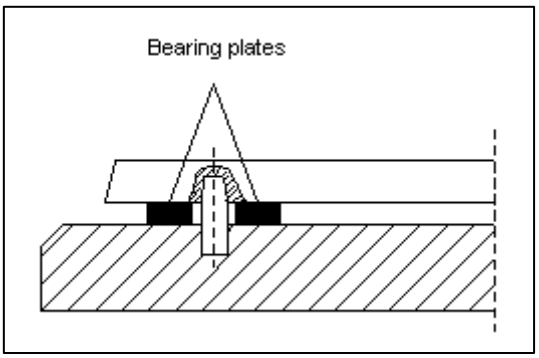

Figure 5: Mounting material for pump with open shaft end

If the pump has two or more anchoring points (see overall diagram or installation plan), ensure that they are not strained axially or radially.

NOTICE

Material damage due to strain on the base plate!

► Place and secure the base plate to the foundation as follows.

✓ Aids, tools, material:
(not included in delivery)
- Foundation bolts
- Steel shims
- Mortar casting compound, vibration free
- Spirit level

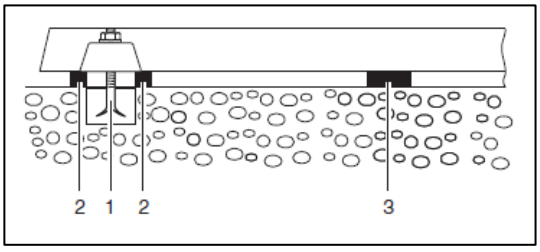

Figure 6: Aligning the base plate

1. Lift the pump unit (→ 4.1.2 Lifting, pg 14).

2. Insert the foundation screws from below into the fastening holes on the base plate.

If using adhesive anchors, observe the manufacturer's information.

3. Place the pump unit on the foundation, inserting the foundation screws into the prepared anchoring holes as you do so.

4. Align the pump unit to the required height and system dimensions as follows using steel shims:
   - Use one steel shim (2) to the left and right of each foundation screw (1).
   - If the distance between the anchoring holes is greater than 700 mm, add additional steel shims (3) on each side of the base plate in the middle.

5. Ensure that the base plate and the steel shims lie flat.

6. Check the maximum permitted height deviation (1 mm/m) laterally and longitudinally using a machine spirit level.

7. Repeat the process until the baseplate is correctly aligned.

5.2.2 Securing the pump unit

Filling out the base plate with a mortar casting compound improves the insulation properties.

1. Fill out the anchoring holes with mortar casting compound.

2. Once the mortar casting compound has set, screw the base plate tightly at three points using the specified tightening torque.

3. Before tightening the remaining screws, compensate for any unevenness in the mounting surface using spacers on each screw.

4. Check the pump unit for tensions using a straitedge.

5. Fill out the inside of the base plate if provided. Knock on the base plate to prevent cavities.

5.2.3 Assembling the motor

Only necessary if the pump unit is completed at the installation location.

Ensure that the shaft is cleaned of anti-rusting agent, and that both coupling halves are pushed onto the shaft. We recommend checking the direction of rotation as per section 6.1.3 (pg 32) before assembling the motor.

⚠ CAUTION

Incorrect direction of rotation on the pump can lead to damage to the mechanical seal and a reduction in performance. Please observe the direction of rotation arrow on the pump.

NOTICE

Incorrectly aligned shafts can cause increased wear on the bearings, seal rings, shaft seals and elastic coupling elements. They can also cause increased noise when the unit is running.

Place the motor on the base plate. Compensate for the height difference between the shafts precisely using shims. The distance between the shaft ends should not exceed 3 mm.

5.3 Fine alignment of the coupling

The unit is correctly aligned when a ruler placed across both halves of the coupling is the same distance from the respective shaft at all points around the circumference. Do not forget to turn the measurement point by hand. Furthermore, both halves of the coupling must be the same distance from each other at all points around the circumference. Check this using a tracer or gauge.

NOTICE

Material damage due to shocks and impacts!

► Do not tilt the two halves of the coupling when pushing them onto the shaft.

► Avoid knocking the pump components.

The central axes of the pump and motor are aligned according to their:

a) position
b) direction

Achieve both of these conditions by inserting or removing shims of different thicknesses under the pump or motor feet as appropriate. Afterwards, tighten the fastening screws of the pump and motor.

a) Position

A ruler placed on the coupling must lie flat on both halves, offset by 90°, around the circumference (→ Figure 7, pg 22).

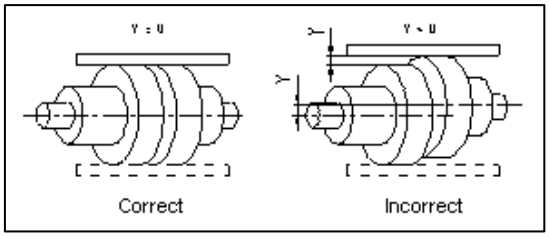

Figure 7: Positional alignment of the shafts

b) Direction

The axial distance (x) between the halves of the coupling must be equal around the entire circumference. Set coupling distance x to 4 - 5 mm, and secure against axial displacement (→ Figure 8, pg 22).

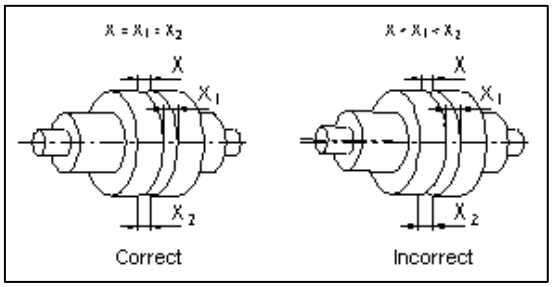

Figure 8: Directional alignment of the shafts

5.3.1 Horizontal configuration

1. Apply a very thin layer of molybdenum disulfide (e.g. Molykote) to the shaft ends on the pump and motor.
2. Insert the keys.
3. If using a fitting device, remove the rubber buffer and heat the two halves of the coupling to around 100 °C.
4. Push the pump-side and motor-side coupling halves onto the shaft until the shaft end is flush with the coupling hub. When assembled, maintain a distance of 4 - 5 mm between the coupling halves.
5. Tighten the grub screws on both coupling halves.
6. Place suitable bearing plates beneath the motor/pump until the ends of the respective shafts are flush.
7. Insert the motor screws, but do not tighten (→ 5.4 Aligning the motor, pg 23).
8. Mount the coupling guard.

The coupling guard must always be mounted after aligning the coupling.

⚠ DANGER

Risk of death due to rotating parts!

► Use personal protective equipment when performing work on the pump.

► Prevent the keys from being slung away when checking the direction of rotation.

► Ensure sufficient clearance to rotating parts.

⚠ **DANGER**

Never operate the pump without the coupling guard.

5.3.2 Vertical configuration

Vertical pumps are always delivered with a complete coupling (assembled on the pump).

1. Apply a very thin layer of molybdenum disulphide (e.g. Molykote) to the shaft ends on the pump.
2. Insert the keys.
3. If using a fitting device, remove the rubber buffer and heat the two halves of the coupling to around 100 °C.
4. Push the pump-side and motor-side coupling halves onto the shaft until the shaft end is flush with the coupling hub. When assembled, maintain a distance of 4 - 5 mm between the coupling halves.
5. Tighten the grub screw on the motor-side coupling half.
6. Place the motor on the pump. Ensure here that both halves of the coupling fit securely.
7. Secure the motor to the pump with screws.

The coupling guard must always be mounted after aligning the coupling.

⚠ **DANGER**

Risk of death due to rotating parts!

- ► Use personal protective equipment when performing work on the pump.
- ► Prevent the keys from being slung away when checking the direction of rotation.
- ► Ensure sufficient clearance to rotating parts.

⚠ **DANGER**

Never operate the pump without the coupling guard.

5.4 Aligning the motor

Horizontal configuration only. Alignment options:

- with shims
- with adjustment screws

5.4.1 Aligning the motor with shims

1. Align the motor so that the two halves of the coupling are precisely flush, using shims if necessary.
2. Check the alignment of the motor to the pump.
3. If the height displacement persists, repeat the alignment process.
4. Afterwards, tighten the motor screws.

5.4.2 Aligning the motor with adjustment screws

Observe the spindle's angle of rotation when adjusting the adjustment screws.

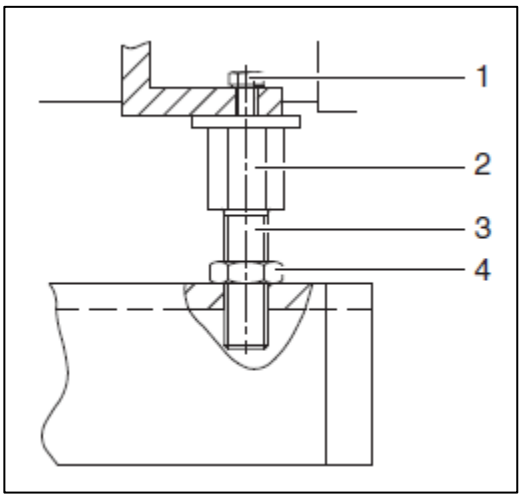

Figure 9: Aligning the motor with adjustment screws

1. Determine the angle required for the wrench rotations for the measured height displacement.
2. Loosen the hexagon head bolt (1)
3. Perform the following steps on all adjustment screws (3):
   - Hold the adjustment screw (3) at the hexagon head (2) and loosen the lock nut (4).
   - Adjust the adjustment screw (3) by the required angle.
   - Hold the adjustment screw (3) at the hexagon head (2) and tighten the lock nut (4).
4. Tighten the hexagon head bolt (1).
5. Check the alignment.
6. If the height displacement persists, repeat the alignment process.
7. Afterwards, tighten the motor screws.

5.5 Planning pipelines

5.5.1 General

Determine the nominal widths of the pipelines, taking the local conditions into account. To keep flow losses to a minimum, avoid sudden constrictions and sharp bends. Route pipelines free of tension and pressure tight. Install them in a way that prevents forces and torques being transferred to the pump. Never use the pump as an anchor point for the pipeline.

Fit the suction pipe rising to the pump and the inlet pipe declining to the pump, in order to prevent the formation of air bubbles. Support the pipes immediately before the pump, and connect without tension. Ensure that the weight of the pipes does not strain the pump. If using short pipes, the nominal widths must be at least equal to those of the pump connections. If using long pipelines, determine the cost-effective nominal width on a case-by-case basis.

⚠ CAUTION

Before commissioning new systems, the tanks, pipelines and connections must be thoroughly cleaned, flushed and blown through. Welding beads, scales and other contaminations often only fall off after a longer period of time. Ensure that they are kept away from the pump by fitting a strainer in the suction pipe.

Taper pieces to larger nominal widths should have an extending angle of approx. 8° to prevent increased pressure losses. Install check valves and shut-off devices depending on the type of system and pump (→ Figure 10, pg 25).

Take appropriate measures to compensate any expansions of the pipelines caused by temperature influences, in order to avoid straining the pump with forces and torques.

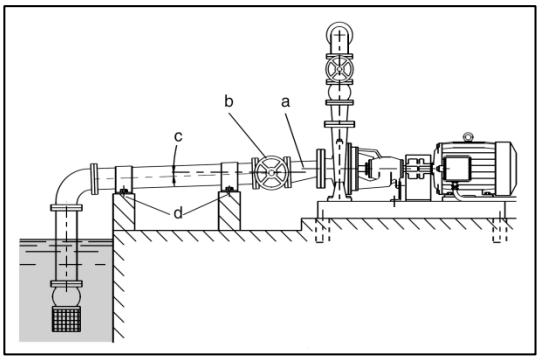

Figure 10: Functional and operating elements

Key:

a Eccentric taper piece
b Shut-off valve
c Suction pipe
d Pipe supports

(not included in delivery)

Control fitting

A control fitting is always required to regulate the pump power and block the pipeline during assembly work.

Check valve

A check valve is always required to protect the pump.

Monitoring fitting

Monitoring fittings are required to monitor the suction and inlet pressure. Monitoring valves help monitor the operating data.

Flushing the shaft seal

If the pumping medium is contaminated, we recommend flushing the shaft seal. This prevents contamination from penetrating the shaft seal, and therefore also prevents excessive wear.

Sealing and flushing fluid pressure

The pressure of sealing and flushing fluid should always be 1 bar above the pump operating pressure.

Sealing the shaft seal

Sealing the shaft seal prevents air entry at high suction heads.

Leak fluid (leakage)

Drain leak fluid using pipes or hoses.

Auxiliary pipes

Route auxiliary pipes according to their nominal connection values, provided that they are not pressurized internally by the pump. The connections on the pump are indicated. All auxiliary pipes must have a control fittings and non-return valve.

5.5.2 Avoiding contaminations in the pipelines

1. Clean all pipeline components and fittings prior to assembly.
2. Ensure that gaskets do not protrude inwards.
3. Remove any blank flanges, plugs, protective films and/or protective coatings on flanges.

NOTICE

Material damage due to contamination in the pump!

► Ensure that the pump is free of contaminations.

5.5.3 Configuring supports and flange connections

NOTICE

Material damage due to excessively high forces and torques in the pipes acting on the pump!

► Do not exceed the permitted values.

1. Calculate the forces in the pipeline and observe all operating conditions:
   - cold/warm
   - empty/filled
   - pressurized/unpressurized
   - change in the flange position
2. Ensure that the pipeline supports have permanent low-friction properties and do not seize up due to corrosion.

5.5.4 Determining nominal widths

Keep the flow resistance as low as possible.

1. Set the nominal width of the suction pipe to be greater than that of the suction nozzle.

2. The flow rate may not exceed 1.5 m/s.

5.5.5 Determining pipeline lengths

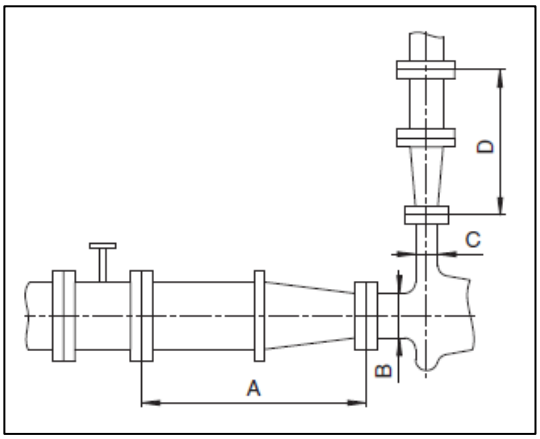

Figure 11: Recommended straight pipeline lengths upstream and downstream of the pump

A > 5x DNs

B DNs

C DNd

D > 5x DNd

Ensure compliance with the recommended pipeline lengths when installing the pump.

Suction side: Shorter lengths are possible, but this may limit the hydraulic performance data.
Pressure side: Shorter lengths are possible, but this may lead to increased noise levels.

5.5.6 Optimizing changes in cross-section and direction

1. Avoid bend radii that are smaller than 1.5 times the nominal pipe width.

2. Avoid sudden changes to the cross-section along the pipeline.

5.5.7 Providing safety and monitoring systems (recommended)

Preventing contamination

1. Install a filter in the suction pipe.

2. Install a differential pressure display with contact manometer to monitor contamination.

Preventing backflow

Install a non-return valve between the discharge nozzle and the shut-off valve to prevent medium backflow after the pump is switched off.

Enabling separation and blocking of the pipelines

For maintenance and repair work.

1. Provide shut-off devices in the suction and pressure pipe.

2. We recommend providing a drainage mechanism.

Enabling measurement of operating conditions

1. Provide manometers in the suction and pressure pipe to measure pressure.
2. Provide a torque measurement instrument on the motor side.
3. Provide a temperature measurement instrument on the pump side.

5.6 Attaching the pipelines

5.6.1 Installing auxiliary pipelines

Observe the manufacturer information for any auxiliary operating systems, if used.

1. Install auxiliary pipelines to the auxiliary connections, sealed and without tension (→ Installation plan).
2. Prevent air pockets by routing the pipelines rising to the pump.

5.6.2 Installing the suction pipe

1. Remove transport and sealing caps on the pump.
2. Fit the filter in the suction pipe to prevent contamination.
3. Prevent air pockets by routing the pipeline rising to the pump.
4. Ensure that the gaskets do not protrude inwards.
5. During suction operation, install a foot valve in the suction pipe to prevent the pump and suction pipe from emptying when not in operation.

NOTICE

Always open the suction-side fitting when operating the pump, and do not use it to control the flow rate.

5.6.3 Installing the pressure pipe

1. Remove transport and sealing caps on the pump.
2. Prevent air pockets by routing the pipeline constantly declining to the pump.
3. Ensure that the gaskets do not protrude inwards.

5.6.4 Checking for lack of tension in the pipeline connection

✓ Pipeline routed and cooled

1. Disconnect the connection flange of the pipelines from the pump.

2. Check whether the pipeline can move freely in all directions in the expected area of expansion:
   - Nominal width < 150 mm: by hand
   - Nominal width > 150 mm: with small lever

3. Ensure that the flanges are plane parallel.

4. Reconnect the connection flange of the pipelines to the pump.

NOTICE

Material damage due to excessively high forces and torques in the pipes acting on the pump!

► Do not exceed the permitted values.

5.7 Electrical connection

⚠ CAUTION

Electrical connection must be carried out by a specialist electrician, in line with the specifications of the local energy supplier or the VDE.

⚠ DANGER

Risk of death from electric shock!

► Only allow work on the electrical systems to be carried out by a qualified electrician.

► Ensure that the supply of electricity is switched off and secured against reactivation when performing all maintenance work.

⚠ DANGER

Risk of death due to rotating parts!

► Use personal protective equipment when performing work on the pump.

► Prevent the keys from being slung away when checking the direction of rotation.

► Ensure sufficient clearance to rotating parts.

5.7.1 Connecting the motor

Observe the manufacturer information for the motor.

Install a motor protection switch to protect the motor. If using three-phase motors with star-delta switch, ensure that the switching points between star and delta are timed very closely together. Longer switching times can lead to damage to the pump.

1. Connect the motor according to the circuit diagram.
2. Ensure that no danger arises due to electrical energy.
3. Install an EMERGENCY STOP switch.
4. Adjust the time relay to the motor power accordingly.

Adjusting the time relay with star-delta activation:

Motor power	Time relay setting
≤ 30 kW	3 s 30%
> 30 kW	5 s 30%

Table 8: Settings for the time relay when using three-phase motors with star-delta switch

NOTICE

Material damage due to improper use of three-phase motor with star-delta switch!

► Adjust the time relay according to the motor power (→ Table 8, pg 30).

6 Commissioning/decommissioning

6.1 Commissioning

6.1.1 Determining the pump configuration

⚠ DANGER

Risk of explosion!

► Ensure that no pumps with gland packing are used in areas at risk of explosion.

► Determine the pump configuration (→ Order data sheet)

Pump configurations relate to the type of shaft seal or auxiliary operating system, for example.

6.1.2 Filling the pump

✓ Auxiliary operating system ready

✓ Preservative removed
(→ 5.1.3 Removing the preservative, pg 18)

1. Fill the pump and suction pipe with pumping medium.
2. Open the suction-side fitting.
3. Open the pressure-side fitting.
4. Open the auxiliary operating systems (if present) and check for flow.
5. Ensure that all connections and joints are sealed.

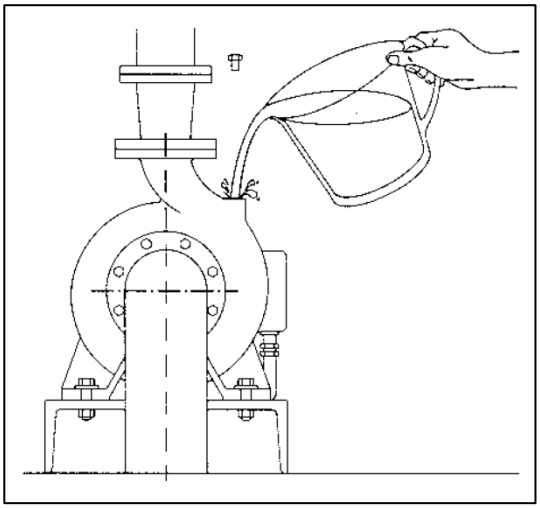

Figure 12: Filling the pump

⚠ CAUTION

Check that there is enough water in the well or feed tank.

Do not operate the pump without water. Dry running can lead to damage to the pump.

⚠ WARNING

Risk of poisoning or injury due to hazardous pumping media!

► Collect any escaping pumping medium safely and dispose of in an environmentally friendly way.

NOTICE

Material damage due to dry running!

► Ensure that the pump is properly filled.

6.1.3 Checking direction of rotation

⚠ CAUTION

Incorrect direction of rotation on the pump can lead to damage to the mechanical seal and a reduction in performance. Please observe the direction of rotation arrow on the pump.

The cast direction of rotation arrow on the pump indicates the specified direction of rotation.

Before checking the direction of rotation, secure the pump against activation.

1. Decouple the motor from the pump.
2. Switch the motor on and immediately off again.
3. Check whether the motor's direction of rotation corresponds to the arrow on the pump.
4. If the direction of rotation is different, reverse this by swapping two phases.
5. Recouple the motor with the pump.
6. Mount the coupling guard.

⚠ DANGER

Risk of death due to rotating parts!

► Use personal protective equipment when performing work on the pump.

► Prevent the keys from being slung away when checking the direction of rotation.

► Ensure sufficient clearance to rotating parts.

After checking the direction of rotation, ensure that all safety and protective mechanisms are reinstalled and reactivated.

⚠ DANGER

Never operate the pump without the coupling guard.

6.1.4 Starting the pump

- ✓ Pump correctly installed and connected
- ✓ Motor correctly installed and connected
- ✓ Motor correctly installed and aligned
- ✓ All connections established, sealed and free of tension
- ✓ Any auxiliary operating systems ready
- ✓ All safety mechanisms installed and function tested
- ✓ Pump correctly prepared, filled and vented

⚠ DANGER

Risk of injury due to running pump!

- ► Do not touch the running pump.
- ► Do not perform any work on the running pump.

⚠ DANGER

Risk of poisoning or injury due to spurting pumping medium!

- ► Use personal protective equipment when performing work on the pump.

NOTICE

Material damage due to dry running!

- ► Ensure that the pump is properly filled.

NOTICE

Open the suction-side fitting, and do not use it to control the flow rate. Do not close the pressure-side fitting!

Do not open the pressure-side fitting above the operating point.

0.1 MPa = 1 bar ≈ 10 m

1. Open the suction-side fitting.
2. Close the pressure-side fitting.
3. Switch on the motor and ensure that it runs quietly.
4. Once the motor has reached its nominal speed, slowly open the pressure-side fitting until the operating point is reached.
5. Ensure a temperature increase of < 50 °C/h if using the pump with hot pumping medium.
6. After the first pressure and temperature loads, check whether the pump is tight.
7. If using hot pumping media, switch the pump off briefly when at operating temperature, check the coupling alignment and realign the motor if necessary (→ 5.4 Aligning the motor, pg 23).
8. Set a slight leakage on the gland packing, if present (→ 6.5.2 Gland packing, pg 37).

6.2 Decommissioning

⚠ DANGER

Risk of injury due to hot pump components!

► Use personal protective equipment when performing work on the pump.

⚠ DANGER

Risk of injury due to running pump!

► Do not touch the running pump.

► Do not perform any work on the running pump.

⚠ WARNING

Risk of poisoning or injury due to hazardous pumping media!

► Use personal protective equipment when performing work on the pump.

► Take the following measures in the event of operating interruptions:

Flow medium behavior	Duration of operating interruption (depending on process)	
	short	long
Solid components settle	► Flush pump.	► Flush pump.
Solidified/frozen, non-corrosive	► Heat or drain pump and containers.	► Drain pump and containers.
Solidified/frozen, corrosive	► Heat or drain pump and containers.	► Drain pump and containers. ► Apply preservative to pump and containers.
Remains fluid, non-corrosive	–	–
Remains fluid, corrosive	–	► Drain pump and containers. ► Apply preservative to pump and containers.

Table 9: Measures depending on the behavior of the pumping medium

Pump to be	Measure
Shut down for longer period	► Take measures according to the pumping medium
Drained	► Close suction and pressure-side fittings.
Disassembled	► Deactivate the motor and secure against unauthorized reactivation.
Put into storage	► Observe the storage measures (→ 4.3 Storage, pg 15).

Table 10: Measures in the event of operational interruption

Drain the pump completely if shutting down for a longer period (approx. 2 - 3 months), or if there is a danger of frost.

NOTICE

This work must be carried out by a specialist service provider.

⚠ CAUTION

Disconnect the pump from the electricity supply if shutting down for a longer period.

6.2.1 Switching off the pump

1. Pressure-side fitting closed (recommended)
2. Switch off the motor.
3. Check all tie bolts and tighten if necessary.

⚠ CAUTION

The pump must move easily for recommissioning.

6.2.2 Draining the pump and protecting against frost

The pump must be drained if there is a danger of frost. A pump that remains empty over a longer period must be preserved.

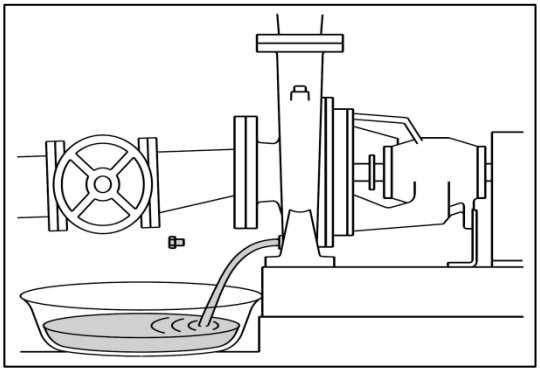

Figure 13: Draining the pump

6.3 Recommissioning

Check that the pump moves easily before recommissioning.

If the pump was preserved after decommissioning, flush it thoroughly before recommissioning.

Perform all further work steps in line with 6.1 Commissioning, pg 31.

Take the following measures before recommissioning following operating interruptions of > 1 year:

Shut down time	Measure
> 1 year	► Check visually for leaks
> 2 years	Replace elastomer seals (gaskets, round seals, shaft seal rings and gland packings). ► Replace anti-friction bearings.

Table 11: Measures following longer shut down times

6.4 Operating the stand-by pump

✓ Stand-by pump filled and vented

Operate the stand-by pump at least once per week.

1. Open the suction-side fitting fully.
2. Open the pressure-side fitting as far as required for the stand-by pump to reach operating temperature and be evenly warmed through (→ 6.1.4 Starting the pump, pg 33).

6.5 Shaft seal

6.5.1 Mechanical seal

NOTICE

Material damage due to dry running!

► Ensure that the pump is properly filled.

Mechanical seals are self-adjusting mechanical shaft seals that require no maintenance. The mechanical seal must never run dry. Ensure therefore that the pump is filled.

Do not reinstall mechanical seals after removing them for inspection or maintenance. Replace them with new seals, or relap the contact surface.

6.5.2 Gland packing

Gland packing consists of a number of compression-moulded rings in a stuffing box. Gland packings can be adjusted by hand with tools.

⚠ WARNING

Excessive tightening places too much tension on the packing rings. This leads to wear and ultimately loss of tightness in the stuffing box.

Replace the gland packing if the leaks in the stuffing box persist. Check at the same that the shaft wearing sleeves are in a good condition. Any worn or scored shaft wearing sleeves can lead to premature destruction of the packing.

NOTICE

Material damage due to dry running!

► Ensure that the pump is properly filled.

7 Maintenance and repair

7.1 General information

We can provide trained customer service technicians for assembly and repair work. Please present proof of the conveyed goods upon request.

(DIN safety data sheet or clearance certificate)

DANGER

Risk of injury due to hot pump components!

► Use personal protective equipment when performing work on the pump.

DANGER

Risk of injury due to running pump!

► Do not touch the running pump.

► Do not perform any work on the running pump.

WARNING

Risk of poisoning or injury due to hazardous pumping media!

► Use personal protective equipment when performing work on the pump.

Ensure that the pump runs smoothly and quietly at all times. Maximum permitted room temperature 40 °C.

The mechanical seal displays only limited or invisible leakage losses (in vapor form). It requires no maintenance.

The reserve pumps must be activated once per week in order to ensure operational readiness. To do so, switch the reserve pumps on and immediately off again. Monitor the function of the additional connections.

7.2 Operational monitoring

Ensure that the pump runs smoothly and quietly at all times. Maximum permitted room temperature 40 °C. The bearing temperature may be up to 50 °C above the room temperature, but may not exceed 90 °C (measured externally on the bearing housing).

NOTICE

Material damage due to dry running!

► Ensure that the pump is properly filled.

► Longer operation against a closed shut-off device is not permitted.

If using a gland packing, this should drip slightly during operation. The gland may only be tightened slightly. Leakage is always required if using pure graphite packing rings. If leakage is too high after a longer period of operation, evenly tighten the nuts on the gland by 1/6 of a rotation, and observe the leakage. If it is no longer possible to adjust the gland, insert an additional packing ring. It is generally not required to replace the entire packing.

If using mechanical seals, these display only limited or invisible leakage losses (in vapor form). They require no maintenance.

The reserve pumps must be activated once per week in order to ensure operational readiness. To do so, switch the reserve pumps on and immediately off again. Monitor the function of the additional connections.

Replace the elastic elements of the coupling promptly should you notice signs of wear over time.

The bearings have a high-quality lithium-soap grease. Under normal operating conditions, this is sufficient for 15,000 operating hours or 2 years. If operating under unfavorable conditions, such as high room temperature, high humidity, dusty air, aggressive industrial atmospheres, etc., check the bearings at an earlier time, and clean and relubricate if necessary. When relubricating, use a lithium-soap grease that is free of resins or acids, does not become brittle and protects against rust.

Only half fill the cavities of the bearings with grease. If necessary, you can also lubricate the bearings with other soap-based greases. As greases with different soap bases may not be mixed, ensure that the bearings are thoroughly washed beforehand. Adjust the necessary relubrication intervals according to the greases used.

1. Test at appropriate intervals:
   - Maintenance of the minimum flow rate
   - Room temperature < 40 °C
   - Temperature of the anti-friction bearings < 90 °C
     (measured on the bearing housing)
   - No change in the normal operating conditions
   - Alignment of the coupling and condition of the elastic elements

2. Please ensure the following for smooth operation:
   - No dry running
   - No leaks
   - No cavitation
   - Gate valve open on suction side
   - Filter free and clean
   - Sufficient inlet pressure
   - No unusual running noises or vibrations
   - No unpermitted leakage on the shaft seal
   - Auxiliary operating systems function correctly

7.3 Maintenance

Service life of the anti-friction bearings in the permitted operating range: > 2 years

Intermittent operation, high temperatures, low viscosity and unfavorable ambient and process conditions can reduce the service life of the anti-friction bearings.

Mechanical seals wear naturally, although this depends heavily on the respective operating conditions. It is therefore not possible to make any general statements about the service life.

DANGER

Risk of death from electric shock!

- ► Only allow work on the electrical systems to be carried out by a qualified electrician.
- ► Ensure that the supply of electricity is switched off and secured against reactivation when performing all maintenance work.

DANGER

Risk of injury due to hot pump components!

- ► Use personal protective equipment when performing work on the pump.

DANGER

Risk of injury due to running pump!

- ► Do not touch the running pump.
- ► Do not perform any work on the running pump.

WARNING

Risk of poisoning or injury due to hazardous pumping media!

- ► Use personal protective equipment when performing work on the pump.

7.3.1 Anti-friction bearings and grease lubrication

Relubricate after no more than 7,500 operating hours or 1 year under normal operating conditions.

1. Clean the anti-friction bearings thoroughly.
2. Use grease with the following properties:
   - lithium soap base

- free of resins
- free of acids
- anti-rust effect
- non-drying

3. Only half fill the cavities in the anti-friction bearings with grease.

7.3.2 Servicing the electric motors

⚠ CAUTION

Electrical connection must be carried out by a specialist electrician, in line with the specifications of the local energy supplier or the VDE.

⚠ DANGER

Risk of death from electric shock!

► Only allow work on the electrical systems to be carried out by a qualified electrician.

► Ensure that the supply of electricity is switched off and secured against reactivation when performing all maintenance work.

⚠ DANGER

Only perform the inspection when the system is switched off and secured.

7.3.3 Servicing the mechanical seals

Mechanical seals feature a functional drop leak (→ manufacturer information)

Mechanical seals are self-adjusting mechanical shaft seals that require no maintenance. The mechanical seal must never run dry. Ensure therefore that the pump is filled.

Do not reinstall mechanical seals after removing them for inspection or maintenance. Replace them with new seals, or relap the contact surface.

➢ In the event of heavy leakage, replace the mechanical seal with auxiliary seals and check that the auxiliary operating systems function properly.

7.3.4 Servicing the gland packing

Gland packing consists of a number of compression-moulded rings in a stuffing box. Gland packings can be adjusted by hand with tools.

⚠ WARNING

Excessive tightening places too much tension on the packing rings. This leads to wear and ultimately loss of tightness in the stuffing box.

NOTICE

Material damage due to dry running!

► Ensure that the pump is properly filled.

If using a gland packing, this should drip slightly during operation. The gland may only be tightened slightly. Leakage is always required if using pure graphite packing rings. If leakage is too high after a longer period of operation, evenly tighten the nuts on the gland by 1/6 of a rotation, and observe the leakage. If it is no longer possible to adjust the gland, insert an additional packing ring or replace the packing rings.

Replacing the packing rings:

1. Remove the old gland packing entirely and clean the stuffing box.

2. Check the surface quality of the shaft running surface.

3. Place new rings around the shaft. When doing this:
   - push in each new ring with the gland
   - rotate each new ring until the joints are offset by 90°

4. Slightly tighten the nuts on the gland by hand, alternating sides. Ensure that the pump shaft rotates easily.

7.4 Sending the pump to the manufacturer

✓ Pump depressurized

✓ Pump completely drained

✓ Electrical connections disconnected and motor secured against reactivation

✓ Pump cooled down

✓ When using couplings with spacer: spacer removed

✓ Auxiliary operating system shut down, depressurized and drained

✓ Manometer removed together with supply lines and holders

1. Only send pumps or individual components to the manufacturer together with a verifiable and completely filled out clearance certificate. Request a clearance certificate from the manufacturer if required.

2. Using the following table, take the action required for returning the pump according to the necessary repair.

Repair	Action for return
At customer	► Return defective component to manufacturer.
At manufacturer	► Flush pump. ► Send complete pump (not disassembled) to manufacturer.
At manufacturer, with guarantee claim	► Only if using hazardous pumping medium: flush pump. ► Send complete pump (not disassembled) to manufacturer.

Table 12: Measures for return

7.5 Disassembling the pump

DANGER

Risk of death from electric shock!

► Only allow work on the electrical systems to be carried out by a qualified electrician.

► Ensure that the supply of electricity is switched off and secured against reactivation when performing all maintenance work.

DANGER

Risk of injury due to hot pump components!

► Use personal protective equipment when performing work on the pump.

DANGER

Risk of injury due to running pump!

► Do not touch the running pump.

► Do not perform any work on the running pump.

WARNING

Risk of poisoning or injury due to hazardous pumping media!

► Use personal protective equipment when performing work on the pump.

✓ Pump depressurized

✓ Pump fully drained, flushed and decontaminated

✓ Electrical connections disconnected and motor secured against reactivation

✓ Pump cooled down

✓ Coupling guard removed

- ✓ When using couplings with spacer: spacer removed
- ✓ Auxiliary operating system shut down, depressurized and drained
- ✓ Manometer removed together with supply lines and holders

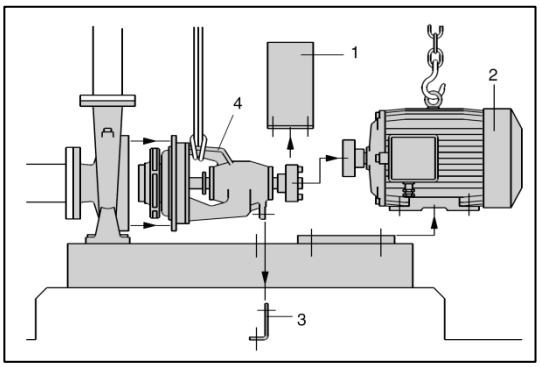

Figure 14: Disassembling the pump

Key:

1 Coupling guard

2 Motor

3 Bearing housing support foot

4 Pump head

During disassembly:

- Precisely mark the installation location and position of all components prior to disassembly.
- Disassemble components concentrically, and do not cant.

- Disassemble the pump (→ Cross-section diagram).

7.6 Ordering spare parts

Please have the following information to hand when ordering spare parts (→ Type plate, cross-section diagram):

- Customer number (if available)
- Short designation of the pump series
- Order number/pump number
- Year of production
- Parts number
- Designation
- Quantity
- Delivery method
- Delivery address

8 Faults and troubleshooting

Please consult the manufacturer should you experience any faults that are not described in the following table, or cannot be traced back to the described causes.

In the following table, each potential fault is given a number. Use this number to find the corresponding cause and remedy in the troubleshooting table.

Fault	Number
Pump does not deliver	1
Flow rate too low	2
Flow rate too high	3
Pumping pressure too low	4
Pumping pressure too high	5
Pump runs noisily	6
Temperature of the anti-friction bearings too high	7
Pump leaks	8
Motor power consumption too high	9

Table 13: Fault/number allocation

Fault number									Cause	Remedy
1	2	3	4	5	6	7	8	9		
X	-	-	-	-	-	-	-	-	Inlet/suction pipe and/or pressure pipe closed by fitting	► Open fitting.
-	X	-	X	-	-	-	-	-	Inlet/suction pipe not completely opened	► Open fitting.
X	X	-	X	-	X	-	-	-	Inlet/suction pipe, pump or suction strainer blocked or encrusted	► Clean inlet/suction pipe, pump or suction strainer.
-	X	-	X	-	X	-	-	-	Cross-section of the inlet/suction pipe too narrow	► Enlarge cross-section. ► Clean suction pipe of encrustations. ► Fully open fitting.
X	-	-	-	-	-	-	-	-	Transport sealing cap not removed	► Remove transport sealing cap. ► Disassemble pump and check for dry running damage.
-	X	-	X	-	X	-	-	-	Suction head too high: $NPSH_{pump}$ is greater than $NPSH_{system}$	► Increase inlet pressure. ► Consult manufacturer.
X	-	-	-	-	X	-	-	-	Inlet/suction pipe and pump not correctly drained or not completely filled.	► Completely fill and drain pump and/or pipeline.
X	-	-	-	-	X	-	-	-	Air pockets in inlet/suction pipe	► Install fitting for venting. ► Correct pipeline routing.
X	X	-	X	-	X	-	-	-	Air sucked in	► Seal source of fault.
X	X	-	X	-	X	-	-	-	Gas component too high: pump cavitated	► Consult manufacturer.
-	X	-	X	-	X	-	-	-	Temperature of pumping medium too high: pump cavitated	► Increase inlet pressure. ► Reduce temperature. ► Consult manufacturer.

Fault number									Cause	Remedy
1	2	3	4	5	6	7	8	9		
-	X	-	X	-	-	-	-	-	Geodetic delivery head and/or pipeline resistance too high	► Remove deposits in pump and/or pressure pipe. ► Install larger impeller and consult manufacturer.
-	X	-	-	X	X	-	-	-	Pressure-side fitting not opened far enough	► Open pressure-side fitting.
X	X	-	-	X	X	-	-	-	Pressure line blocked	► Clean pressure line.
X	X	-	X	-	X	-	-	-	Incorrect direction of rotation on pump	► Swap any two phases on motor.
X	X	-	X	-	-	-	-	-	Speed too low	► Compare required motor speed with pump type plate. Replace motor if necessary. ► Increase speed if possible.
-	X	-	X	-	X	X	-	-	Pump components worn	► Replace worn pump components.
-	-	X	X	-	X	-	-	X	Pressure-side fitting opened too far	► Throttle with pressure-side fitting. ► Machine down impeller. Consult manufacturer and adjust impeller diameter.
-	-	X	-	-	X	-	-	X	Geodetic delivery head, pipeline resistance and/or other resistances lower than designed	► Throttle flow rate with pressure-side fitting. Observe minimum flow rate here. ► Machine down impeller. Consult manufacturer and adjust impeller diameter.
-	-	X	-	X	-	-	-	-	Viscosity lower than indicated	► Machine down impeller. Consult manufacturer and adjust impeller diameter.
-	-	X	-	X	X	X	-	X	Speed too high	► Compare required motor speed with pump type plate. Replace motor if necessary. ► Reduce speed if possible.
-	-	X	-	X	X	-	-	X	Impeller diameter too high	► Throttle flow rate with pressure-side fitting. Observe minimum flow rate here. ► Machine down impeller. Consult manufacturer and adjust impeller diameter.
X	X	-	X	-	X	-	-	-	Impeller imbalanced or blocked	► Disassemble pump and check for dry running damage. ► Clean impeller.
-	X	-	X	-	X	-	-	-	Hydraulic pump components dirty, sticky or encrusted	► Disassemble pump. ► Clean components.

Fault number									Cause	Remedy
1	2	3	4	5	6	7	8	9		
-	-	-	-	-	-	X	-	X	Defective anti-friction bearing in motor	► Replace anti-friction bearing.
-	-	-	-	-	-	X	-	-	Lubricant: too much, too little or not suitable	► Reduce, increase or replace lubricant.
-	-	-	-	-	-	-	X	-	Tie bolts not tightened correctly	► Tighten tie bolts.
-	-	-	-	-	-	-	X	-	Mechanical seal worn	► Replace mechanical seal.
-	-	-	-	-	-	-	X	-	Defective casing seal	► Replace casing seal.
-	-	-	-	-	-	-	X	-	Shaft sleeve penetrated	► Replace shaft sleeve and round seal.
-	-	-	-	-	X	X	X	X	Pump under tension	► Check pipeline connections and pump fastening. ► Check coupling alignment. ► Check support foot fastening.
-	-	-	-	-	X	X	-	-	Coupling incorrectly aligned	► Align coupling.
-	X	-	X	-	X	-	-	X	Motor runs on 2 phases	► Check fuse and replace if necessary. ► Check wire connections and insulation.

Table 14: Troubleshooting table

9 Appendix

9.1 Spare parts list for constant operation over two years as per DIN 24296

According to VDMA 24296, we recommend having the following spare parts when operating N volute-casing centrifugal pumps for over two years, depending on the number of operated pumps of a single size:

Part no.	Part designation	Number of identical pumps (including reserve pumps)						
		2	3	4	5	6 and 7	8 and 9	> 9
		Set/quantity of spare parts						
60, 210, 211	Pump shaft with small parts	1	1	2	2	2	3	30%
20, 65	Impeller with small parts	1	1	1	2	2	3	30%
200	Anti-friction bearings (set)	1	1	2	2	3	4	50%
400, 403, 410	Casing seals (set)	1	1	1	2	2	3	40%
404	Shaft seals (set)	1	1	2	2	3	4	50%
250/251	Mechanical seal	2	3	4	5	6	7	50%
240, 56	Gland packing (set)	2	2	2	3	3	4	30%
70/71	Shaft wearing sleeve	2	2	2	3	3	4	50%

Table 15: Spare parts for constant operation over two years

9.2 SKT volute-casing centrifugal pump cross-section diagram

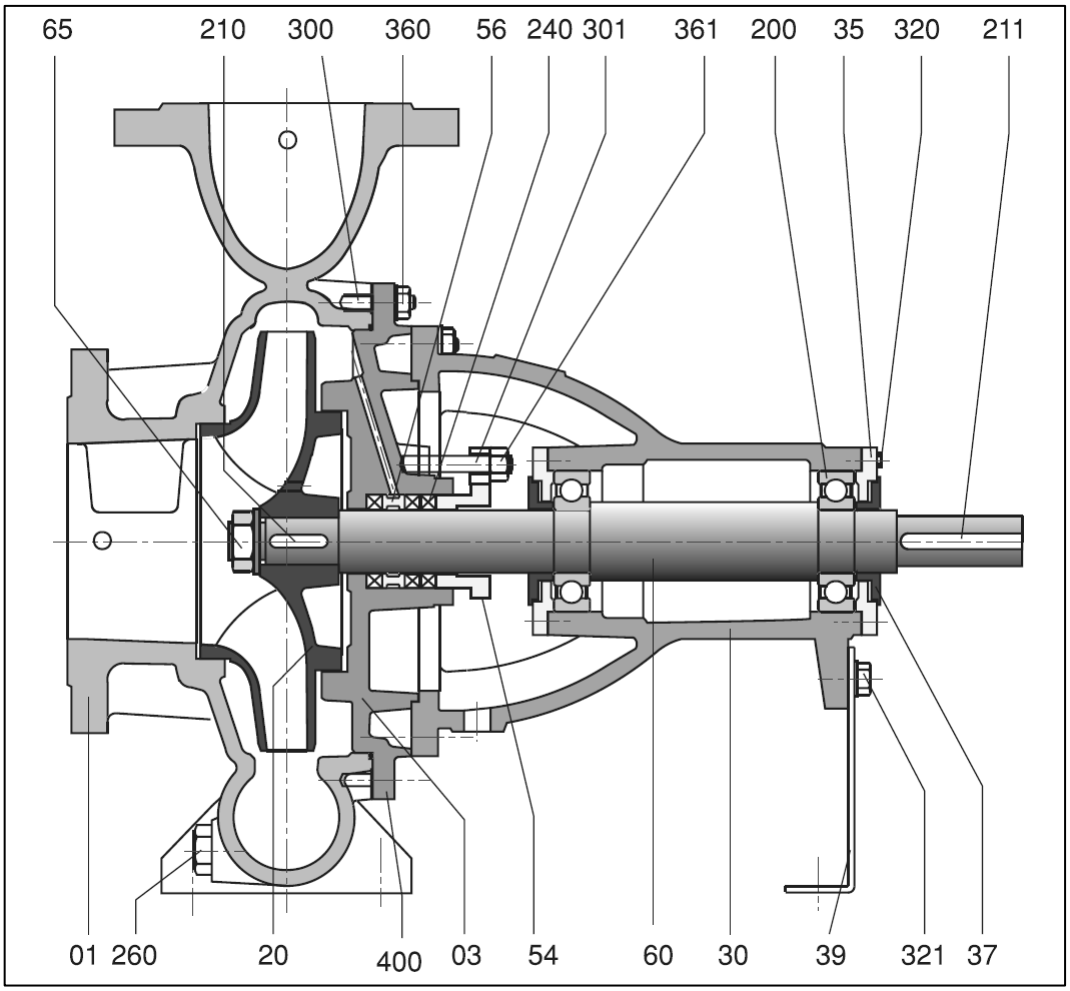

Figure 15: Cross-section diagram of SKT volute-casing centrifugal pump, standard

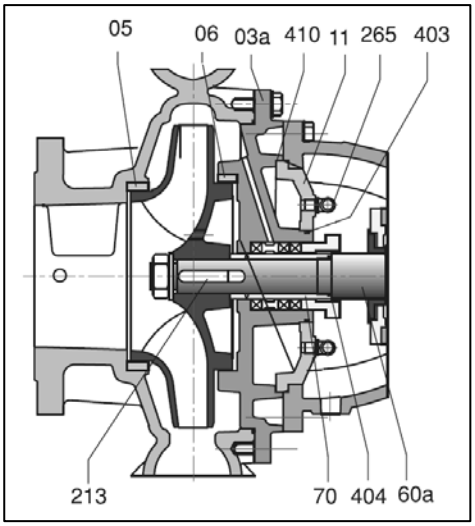

Figure 16: Pump with casing wear rings

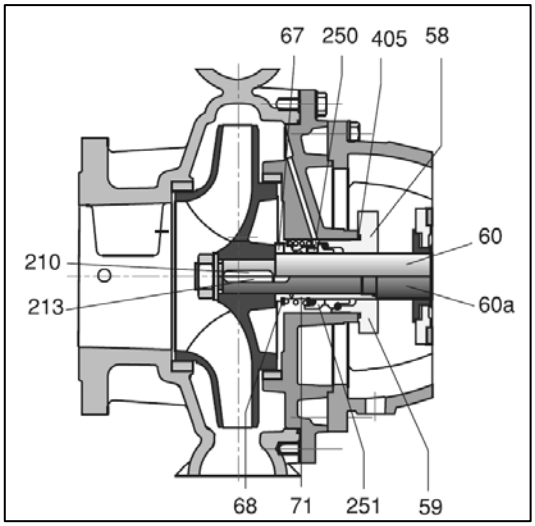

Figure 17: Pump with mechanical seal

Item	Designation	Item	Designation
01	Pump casing	200	Grooved ball bearing
03	Discharge cover	210	Impeller key
03a	Discharge cover with cooler	211	Coupling key
05	Casing wear ring	213	Impeller key
06	Casing wear ring	240	Gland packing
11	Cooler cover	250	Mechanical seal
20	Impeller	251	Mechanical seal
30	Bearing housing	260	Screwed plug
35	Bearing cover	265	Cooling pipes
37	Thrower	300	Stud
39	Support foot	301	Stud
54	Gland	320	Screw
56	Lantern ring	321	Screw
58	Mechanical seal cover	360	Nut
59	Mechanical seal cover	361	Nut
60	Pump shaft	400	O-Ring
60a	Pump shaft	403	O-Ring
65	Impeller nut	404	O-Ring
67	Spacer ring	410	Gasket
68	Spacer ring		
70	Shaft wearing sleeve		
71	Shaft wearing sleeve		

Table 16: Parts list for SKT volute-casing centrifugal pump

9.3 Characteristic curves for SKT centrifugal pumps

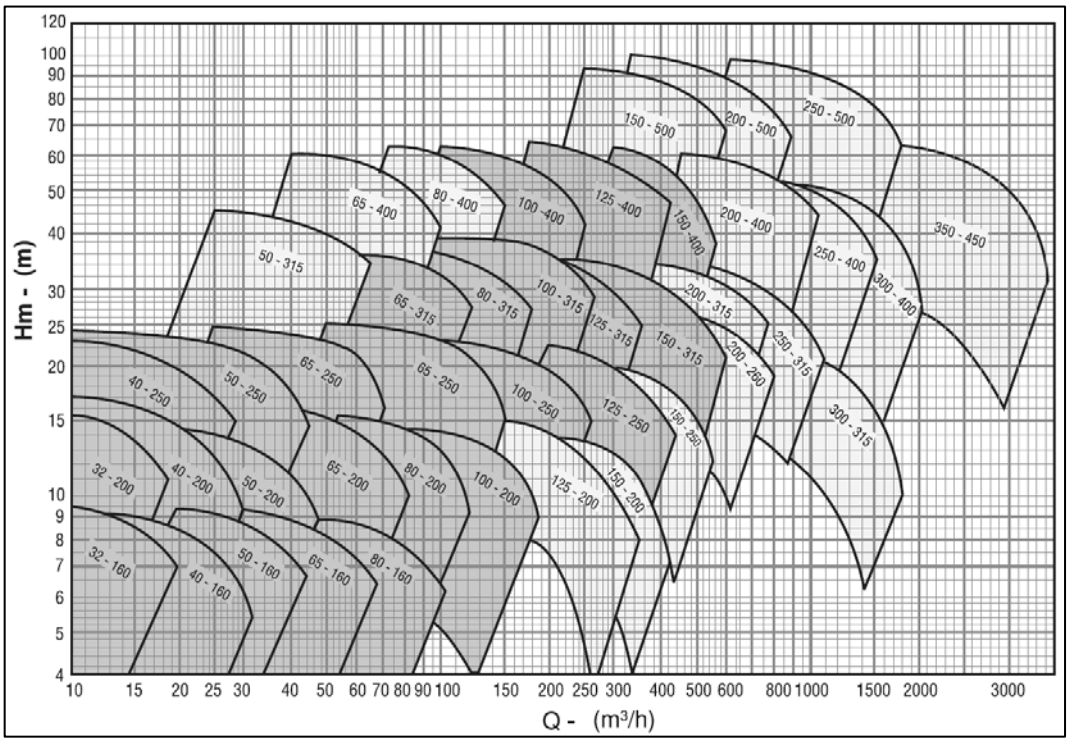

Figure 18: Collective characteristic curve for SKT with speed at 1450 rpm

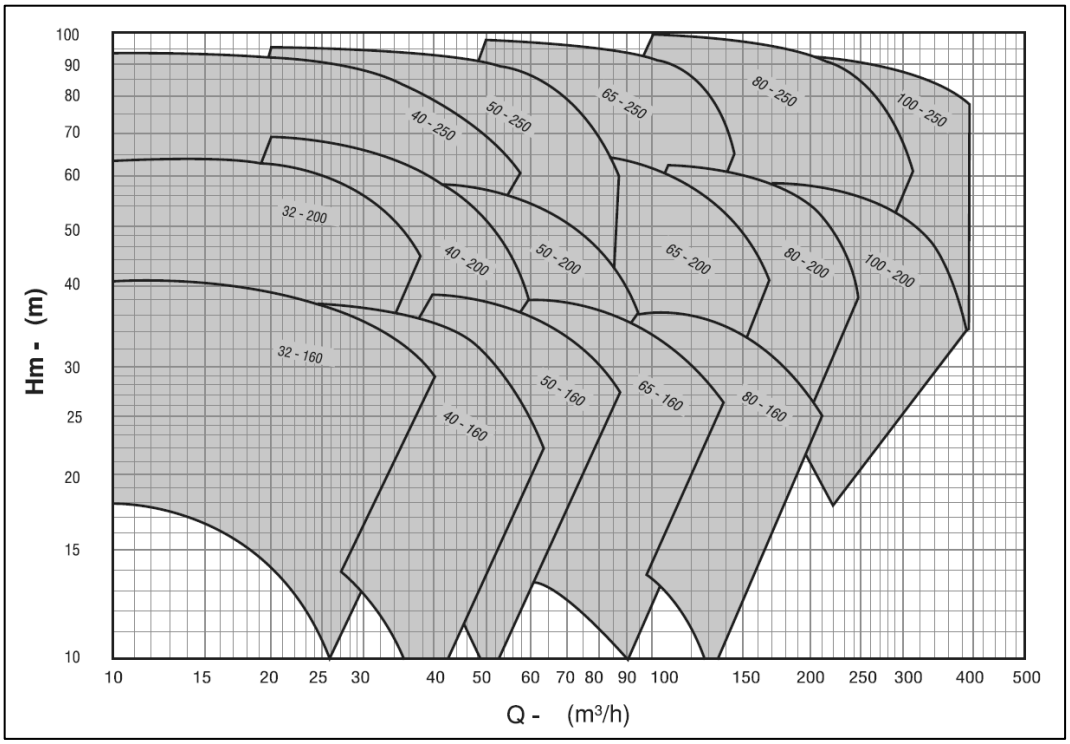

Figure 19: Collective characteristic curve for SKT with speed at 2900 rpm

9.4 Declaration of Conformity as per EC Directive 2006/42/EC, Annex IIA

We hereby declare under our sole responsibility as manufacturer that the following machine series of the type, as well as the configurations distributed by us, conform to the relevant specifications of the **EC Machinery Directive 2006/42/EC**.

Designation: **SKT**

Pump number: 172000 - 210000

The machine also corresponds with the following directives published in the Official Journal of the European Union:

- Niederspannungsrichtlinie (2014/35/EU)
- EMV-Richtlinie (2014/30/EU)

This declaration shall cease to be valid in the event of any modifications to the machine and/or its protective mechanisms not agreed with us and approved in writing.

Applied harmonized standards and their references in the Official Journal of the European Union:

- DIN EN 809 : 2012
- DIN EN ISO 12100 : 2011
- DIN EN ISO 13732 : 2008
- DIN EN ISO 13849-1 : 2008
- DIN EN ISO 13857-1 : 2008
- DIN EN 60034 : 2007
- DIN EN 60204-1 : 2009
- DIN EN 55024 : 2011

Authorized representative for the composition of technical documentation for OSNA-Pumpen GmbH:

Mr. Rik Arensmann
Brückenstrasse 3
49090 Osnabrück, Germany

Osnabrück, 12.01.2017 i.V. Arensmann

Rik Arensmann
Technical Director/QM Officer

9.5 Clearance Certificate

Please copy and send with the pump.

Clearance Certificate

Legal provisions oblige all businesses to protect their employees, other persons and the environment from damaging effects when handling hazardous substances. Products and their components may therefore only be repaired or inspected when the following declaration has been fully and correctly filled out and signed by an authorized and qualified specialist. Please provide the necessary information should safety measures on the part of the system owner still be required despite complete draining and cleaning. This clearance certificate is part of the repair or inspection order.

We hereby assure that the enclosed device

Type: _____

Serial no.: _____

is free of substances that are hazardous to health. No special safety measures are required for further handling. The device was fully drained and thoroughly cleaned inside and outside before dispatch.

Company/institute: _____

Address: _____

Town/city, ZIP code: _____

Phone: _____

Name: _____

Position: _____

Date: _____

Signature,
company stamp: _____

Notes

Notes

Notes

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SYSTEMS
WATER TREATMENT
ENGINEERING
SERVICES

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