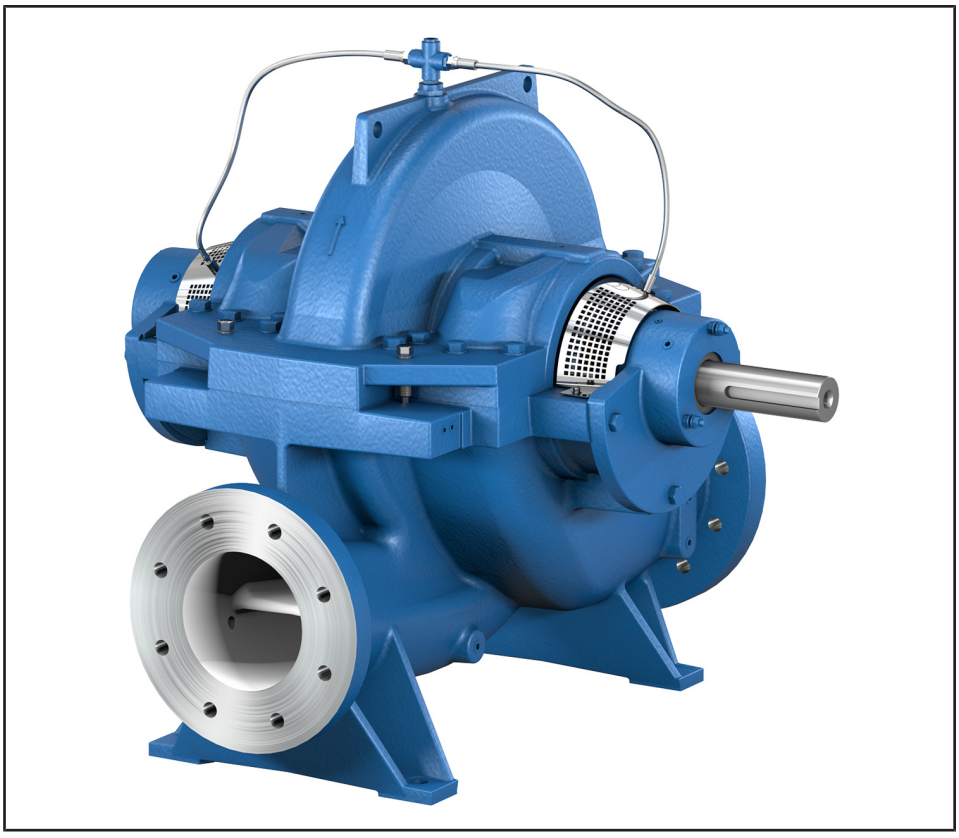
Axially Split Volute Casing Pump

Omega / Omega V

Horizontal Installation Type 3E
Vertical Installation Types DB, DK, DP, DJ

Installation/Operating Manual



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Installation/Operating Manual Omega / Omega V

Original operating manual

Subject to technical modification without prior notice.

Contents

Glossary

Certificate of decontamination

A certificate of decontamination is enclosed by the customer when returning the product to the manufacturer to certify that the product has been properly drained to eliminate any environmental and health hazards arising from components in contact with the fluid handled.

Discharge line

The pipeline which is connected to the discharge nozzle

Drive end

The side of the pump which faces the motor

Hydraulic system

The part of the pump in which the kinetic energy is converted into pressure energy

Non-drive end

The side of the pump which faces away from the motor

Pool of pumps

Customers/operators' pumps which are purchased and stored regardless of their later use.

Pump

Machine without drive, additional components or accessories

Pump set

Complete pump set consisting of pump, drive, additional components and accessories

Suction lift line/suction head line

The pipeline which is connected to the suction nozzle

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1 General

1.1 Principles

This operating manual is valid for the type series and variants indicated on the front cover.

The operating manual describes the proper and safe use of this equipment in all phases of operation.

The name plate indicates the type series and size, the main operating data, the order number and the order item number. The order number and order item number clearly identify the pump set and serve as identification for all further business processes.

In the event of damage, immediately contact your nearest KSB service facility to maintain the right to claim under warranty.

1.2 Installation of partly completed machinery

To install partly completed machinery supplied by KSB refer to the sub-sections under Servicing/Maintenance.

1.3 Target group

This operating manual is aimed at the target group of trained and qualified specialist technical personnel. (⇨ Section 2.3, Page 8)

1.4 Other applicable documents

Table 1: Overview of other applicable documents

Document	Contents
Data sheet	Description of the technical data of the pump (set)
General arrangement drawing / outline drawing	Description of mating dimensions and installation dimensions for the pump (set), weights
Drawing of auxiliary connections	Description of auxiliary connections
Hydraulic characteristic curve	Characteristic curves showing head, NPSH required, efficiency and power input
General assembly drawing[1)]	Sectional drawing of the pump
Sub-supplier product literature[1)]	Operating manuals and other product literature describing accessories and integrated machinery components
Spare parts lists[1)]	Description of spare parts
Piping layout[1)]	Description of auxiliary piping
List of components[1)]	Description of all pump components
Assembly drawing[1)]	Sectional drawing of the installed shaft seal

For accessories and/or integrated machinery components, observe the relevant manufacturer's product literature.

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1 If included in agreed scope of supply

1.5 Symbols

Table 2: Symbols used in this manual

Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇨	Result of an action
⇨	Cross-references
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product

1.6 Key to safety symbols/markings

Table 3: Definition of safety symbols/markings

Symbol	Description
DANGER	**DANGER** This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
WARNING	**WARNING** This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
CAUTION	**CAUTION** This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	**Explosion protection** This symbol identifies information about avoiding explosions in potentially explosive atmospheres in accordance with EU Directive 2014/34/EU (ATEX).
	**General hazard** In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	**Electrical hazard** In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	**Machine damage** In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.

2 Safety

DANGER

All the information contained in this section refers to hazardous situations.

In addition to the present general safety information the action-related safety information given in the other sections must be observed.

2.1 General

- This operating manual contains general installation, operating and maintenance instructions that must be observed to ensure safe operation of the system and prevent personal injury and damage to property.
- Comply with all the safety instructions given in the individual sections of this operating manual.
- The operating manual must be read and understood by the responsible specialist personnel/operators prior to installation and commissioning.
- The contents of this operating manual must be available to the specialist personnel at the site at all times.
- Information and markings attached directly to the product must always be complied with and kept in a perfectly legible condition at all times. This applies to, for example:
  - Arrow indicating the direction of rotation
  - Markings for connections
  - Name plate
- The operator is responsible for ensuring compliance with all local regulations not taken into account.

2.2 Intended use

- The pump (set) must only be operated in the fields of application and within the use limits specified in the other applicable documents. (⇨ Section 1.4, Page 6)
- Only operate pumps/pump sets which are in perfect technical condition.
- Do not operate the pump (set) in partially assembled condition.
- Only use the pump (set) to handle the fluids described in the data sheet or product literature of the pump variant.
- Never operate the pump (set) without the fluid to be handled.
- Observe the minimum flow rate and maximum flow rate indicated in the data sheet or product literature (to prevent overheating, mechanical seal damage, cavitation damage, bearing damage, etc).
- Always operate the pump (set) in the direction of rotation it is intended for.
- Do not throttle the flow rate on the suction side of the pump (to prevent cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.

2.3 Personnel qualification and training

All personnel involved must be fully qualified to transport, install, operate, maintain and inspect the machinery this manual refers to.

The responsibilities, competence and supervision of all personnel involved in transport, installation, operation, maintenance and inspection must be clearly defined by the operator.

Deficits in knowledge must be rectified by means of training and instruction provided by sufficiently trained specialist personnel. If required, the operator can commission the manufacturer/supplier to train the personnel.

Training on the pump (set) must always be supervised by technical specialist personnel.

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2.4 Consequences and risks caused by non-compliance with this manual

- Non-compliance with these operating instructions will lead to forfeiture of warranty cover and of any and all rights to claims for damages.
- Non-compliance can, for example, have the following consequences:
  - Hazards to persons due to electrical, thermal, mechanical and chemical effects and explosions
  - Failure of important product functions
  - Failure of prescribed maintenance and servicing practices
  - Hazard to the environment due to leakage of hazardous substances

2.5 Safety awareness

In addition to the safety information contained in this operating manual and the intended use, the following safety regulations shall be complied with:

- Accident prevention, health regulations and safety regulations
- Explosion protection regulations
- Safety regulations for handling hazardous substances
- Applicable standards, directives and laws

2.6 Safety information for the operator/user

- Fit protective equipment (e.g. contact guards) supplied by the operator for hot, cold or moving parts, and check that the equipment functions properly.
- Do not remove any protective equipment (e.g. contact guards) during operation.
- Provide the personnel with protective equipment and make sure it is used.
- Contain leakages (e.g. at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) so as to avoid any danger to persons and the environment. Adhere to all relevant laws.
- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)
- If stopping the pump does not increase potential risk, fit an emergency-stop control device in the immediate vicinity of the pump (set) during pump set installation.

2.7 Safety information for maintenance, inspection and installation

- Modifications or alterations of the pump (set) are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts/components authorised by the manufacturer. The use of other parts/components can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that maintenance, inspection and installation are performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- Only perform work on the pump set when it has been disconnected from the power supply (de-energised).
- The pump (set) must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.

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- When taking the pump set out of service always adhere to the procedure described in the manual. (⇨ Section 6.3, Page 54)
- Decontaminate pumps which handle fluids posing a health hazard. (⇨ Section 7.3, Page 62)
- As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇨ Section 6.1, Page 47)

2.8 Unauthorised modes of operation

Never operate the pump (set) outside the limits stated in the data sheet and in this operating manual.

The warranty relating to the operating reliability and safety of the pump (set) supplied is only valid if the equipment is used in accordance with its intended use. (⇨ Section 2.2, Page 8)

2.9 Explosion protection

DANGER

Always observe the information on explosion protection given in this section when operating the product in potentially explosive atmospheres.

Pumps/Pump sets must not be used in potentially explosive atmospheres unless marked as explosion-proof **and** identified as such in the data sheet.

Special conditions apply to the operation of explosion-proof pump sets in accordance with EU Directive *2014/34/EU (ATEX)*.

Especially adhere to the sections in this manual marked with the symbol opposite and the following sections, (⇨ Section 1.6, Page 7) to (⇨ Section 2.9.3, Page 11)
The explosion-proof status is only assured if the product is used in accordance with its intended use.
Never operate the product outside the limits stated in the data sheet and on the name plate.
Prevent impermissible modes of operation at all times.
For information on application options of individual components (if any) in potentially explosive atmospheres, refer to the manufacturer's product literature.

2.9.1 Marking

Pump

The marking on the pump refers to the pump part only.

Example of such marking:
II 2G Ex h IIC T5-T1 Gb

Refer to the Temperature limits table for the maximum temperatures permitted for the individual pump variants. (⇨ Section 2.9.2, Page 11)

The pump complies with the requirements of type of protection constructional safety "c" to ISO 80079-37.

Shaft coupling

An EC manufacturer's declaration is required for the shaft coupling; the shaft coupling must be marked accordingly.

Motor

The motor must be considered separately.

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2.9.2 Temperature limits

In normal pump operation, the highest temperatures are to be expected at the surface of the pump casing, at the shaft seal and in the bearing areas.
The surface temperature at the pump casing corresponds to the temperature of the fluid handled. If the pump is heated in addition, the operator of the system is responsible for observing the specified temperature class and fluid temperature (operating temperature).

The table lists the temperature classes and the resulting maximum permissible temperature limits of the fluid handled. The values shown correspond to the theoretical limits. They include only a general safety margin for the mechanical seal. For single mechanical seals, the safety margin required for specific operating conditions and mechanical seal designs may be substantially higher. If operating conditions differ from those stated on the data sheet, or if different mechanical seals are used, the actual safety margin required needs to be determined individually. If in doubt please contact the manufacturer.

The temperature class specifies the maximum permissible temperature at the surface of the pump set during operation.

For the permissible operating temperature of the pump in question refer to the data sheet.

Table 4: Temperature limits

Temperature class to EN 13463-1 or ISO 80079-36	Maximum permissible fluid temperature
T1	Maximum 140 °C[2)]
T2	Maximum 140 °C
T3	Maximum 140 °C
T4	80 °C
T5	45 °C
T6	Not permitted

Temperature class T5 Based on an ambient temperature of 40 °C and proper maintenance and operation, compliance with temperature class T5 is warranted in the area of the rolling element bearings. If the ambient temperature exceeds 40 °C, contact the manufacturer.

Temperature class T6 A special design is required to comply with the requirements of temperature class T6 in the bearing area.

Misuse, malfunctions or non-compliance with the instructions may result in substantially higher temperatures.

If the pump is to be operated at a higher temperature, the data sheet is missing or if the pump is part of a pool of pumps, contact KSB for the maximum permissible operating temperature.

2.9.3 Repair

Special regulations apply to repair work on explosion-proof pumps. Modifications or alterations of the pump set can affect explosion protection and are only permitted after consultation with the manufacturer.

Repair work at the flameproof joints must only be performed in accordance with the manufacturer's instructions. Repair to the values in Table 2 of EN 60079-1 is not permitted.

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2 Depending on the material variant

3 Transport/Storage/Disposal

3.1 Checking the condition upon delivery

1. On transfer of goods, check each packaging unit for damage.
2. In the event of in-transit damage, assess the exact damage, document it and notify KSB or the supplying dealer and the insurer about the damage in writing immediately.

3.2 Transport

DANGER

Lifting lugs of pump/motor/baseplate overloaded

Danger to life from falling parts!

- Never transport the pump set components (pump/motor/baseplate) in any way other than as described in the Transport section.
- Refer to the weights of the individual components stated in the manufacturer's product literature.

DANGER

The pump (set) could slip out of the suspension arrangement

Danger to life from falling parts!

- Always transport the pump (set) in the specified position.
- Never attach the suspension arrangement to the free shaft end or the motor eyebolt.
- Observe the information about weights, centre of gravity and fastening points.
- Observe the applicable local accident prevention regulations.
- Use suitable, permitted lifting accessories, e.g. self-tightening lifting tongs.

For transporting the motor, observe the motor supplier's product literature!
To transport the pump/pump set suspend it from the lifting tackle as shown.

Fig. 1: The angle of pull must not be greater than 90°!

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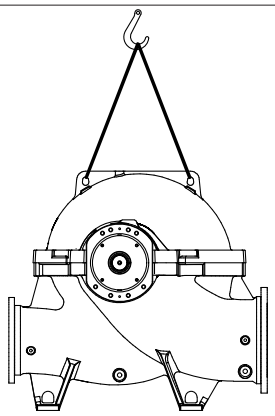
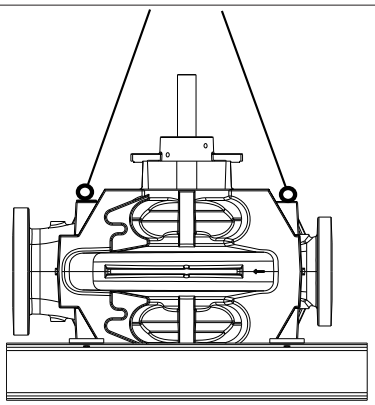
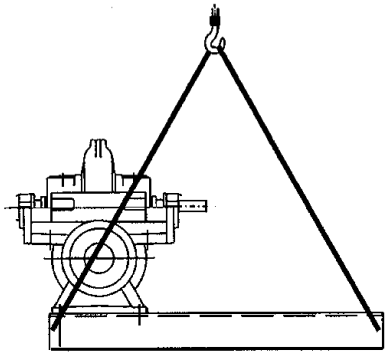
Table 5: Transport options



Transporting the pump horizontally
(figure 0 bare-shaft pump)

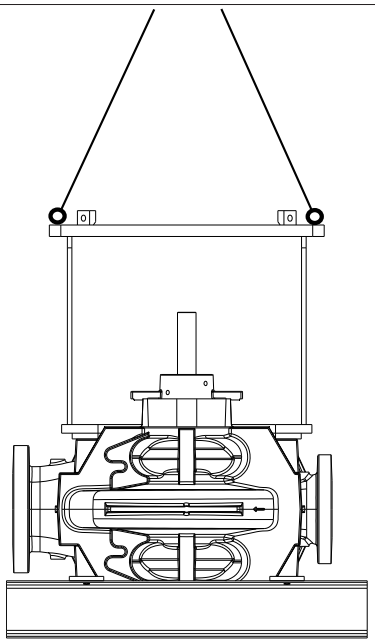


Transporting the pump vertically
(figure 0 bare-shaft pump or installation type DJ)

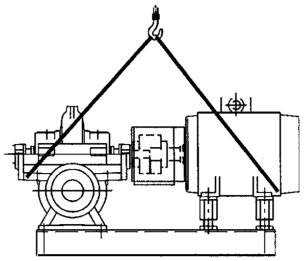


Transporting the pump with base frame
(figure 0 bare-shaft pump)

- Motor size 315 and larger
- Total weight (of the pump set) more than 1500 kg

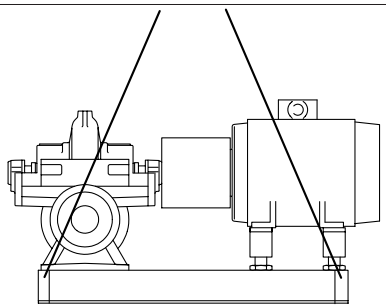


Transporting the pump vertically
(installation types DB and DK)



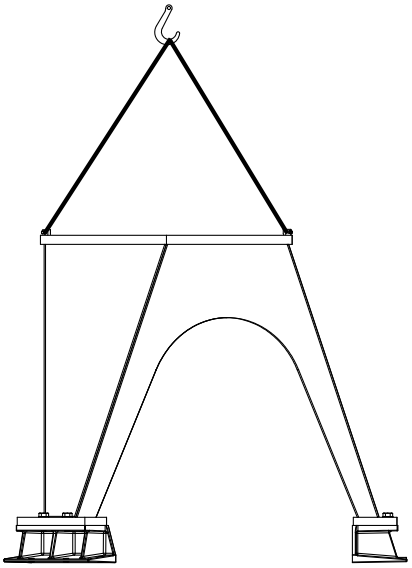
Transporting the pump set on the base frame (installation type 3E)

- Up to motor size 280 (IEC standard)
- Up to a total weight (of the pump set) of 1500 kg



Transporting the pump set on the base frame (installation type 3E)
Use the hooks welded to the baseplate!

- Up to motor size 280 (IEC standard)
- Up to a total weight (of the pump set) of 1500 kg



Transporting the base frame (installation type DP)

3.3 Storage/preservation

⚠ WARNING

Installation on mounting surfaces which are unsecured and cannot support the load

Personal injury and damage to property!

- ▷ Use a concrete of compressive strength class C25/30 which meets the requirements of exposure class XS1 to EN 206 .
- ▷ The mounting surface must be set, even, and level.
- ▷ Observe the weights indicated.

CAUTION

Damage during storage due to humidity, dirt or vermin

Corrosion/contamination of pump (set)!

- ▷ For outdoor storage cover the pump (set) and accessories with waterproof material and protect against condensation.

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CAUTION

Wet, contaminated or damaged openings and connections

Leakage or damage to the pump!

- ▷ Clean and cover pump openings and connections as required prior to putting the pump into storage.

CAUTION

Bearings in the same position for a prolonged period of time

Damage to the bearings!

- ▷ Manually rotate the shaft once a month with suitable tools.
- ▷ Store the pump in a room isolated from vibrations.

CAUTION

Pump stored too long or incorrectly

Damage to the pump!

- ▷ Check especially the rolling element bearings and the lubricant. If any damage is suspected, replace the rolling element bearings.

NOTE

Observe the manufacturer's instructions for application/removal of the preservative.

If commissioning is to take place some time after delivery, we recommend that the following measures be taken:

- Store the pump and supplied components under dry, vibration-free conditions, and, if possible, in their original packaging.
- The ambient temperatures for transport and storage must not be below -20 °C or above 60 °C.

1. Manually rotate the pump shaft once a month with a suitable tool.
2. Spray preservative through the suction nozzle and discharge nozzle. It is advisable to then close the pump nozzles (e.g. with plastic caps or similar).

3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇨ Section 7.3, Page 62)
2. Flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pump has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump must also be neutralised, and anhydrous inert gas must be blown through the pump to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pump.
   Indicate any safety measures and decontamination measures taken.
   (⇨ Section 11, Page 102)

NOTE

If required, a blank certificate of decontamination can be downloaded from the following web site: www.ksb.com/certificate_of_decontamination

3.5 Disposal

⚠ WARNING

Fluids handled, consumables and supplies which are hot and/or pose a health hazard

Hazard to persons and the environment!

- ▷ Collect and properly dispose of flushing fluid and any fluid residues.
- ▷ Wear safety clothing and a protective mask if required.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

1. Dismantle the pump (set).
   Collect greases and other lubricants during dismantling.
2. Separate and sort the pump materials, e.g. by:
   - Metals
   - Plastics
   - Electronic waste
   - Greases and other lubricants
3. Dispose of materials in accordance with local regulations or in another controlled manner.

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4 Description of the Pump (Set)

4.1 General description

- Volute casing pump installed in a horizontal or vertical position
- Volute casing pump with double-entry radial impeller
- Pump for handling fluids in water works, irrigation pumping systems and drainage pumping systems, power stations and industrial water supply

4.2 Product information as per Regulation No. 1907/2006 (REACH)

For information as per European chemicals regulation (EC) No. 1907/2006 (REACH) see https://www.ksb.com/en-global/company/corporate-responsibility/reach.

4.3 Designation

Example: Omega V 150 - 460 A GB P M

Table 6: Designation key

Code	Description	
Omega	Type series	
V	Design	
	[3)]	Horizontal installation
	V	Vertical installation
150	Nominal discharge nozzle diameter [mm]	
460	Nominal impeller diameter [mm]	
A	Impeller type	
GB	Material variant	
	GB	Grey cast iron / bronze
	GC	Grey cast iron / chrome steel
	SB	Nodular cast iron / bronze
	SC	Nodular cast iron / chrome steel
	DD_{35}	Duplex stainless steel / duplex stainless steel
P	Shaft seal	
	P	Gland packing
	G	Mechanical seal
M	Bearing lubrication	
	F	Grease
	M	Fluid handled

3 Blank

4.4 Name plate

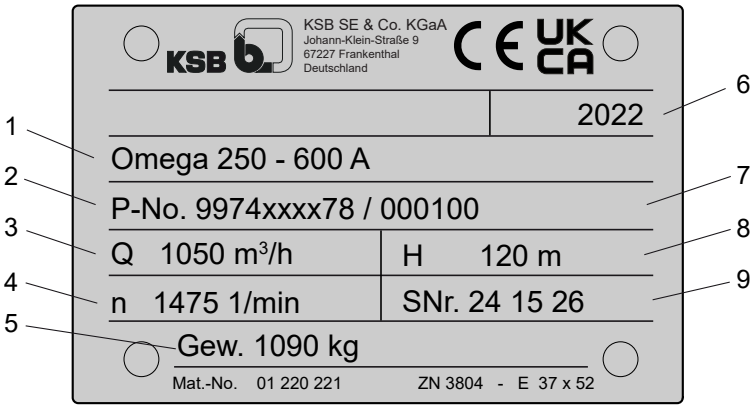

Fig. 2: Name plate (example)

1	Designation of the pump set	6	Year of production
2	Order number	7	Order item number
3	Flow rate	8	Head
4	Speed	9	Serial number
5	Weight of bare-shaft pump		

4.5 Design details

Design

- Volute casing pump
- Horizontal installation / vertical installation
- Single-stage
- Nominal discharge nozzle diameter: 80 mm - 400 mm

Pump casing

- Axially split volute casing
- Volute casing with integrally cast pump feet
- Replaceable casing wear rings
- Mating dimensions to EN or ASME

Impeller type

- Double-entry radial impeller[4)]

Pump shaft

- Completely dry shaft
- Shaft protecting sleeves in the seal area

Shaft seal

- Gland packing
- Mechanical seal

Bearings

For horizontal installation:

- Grease-packed rolling element bearings sealed for life

For vertical installation:

- Product-lubricated plain bearing at the bottom / rolling element bearings, greased for life, on top

4 Optionally with impeller wear rings

4.6 Configuration and function

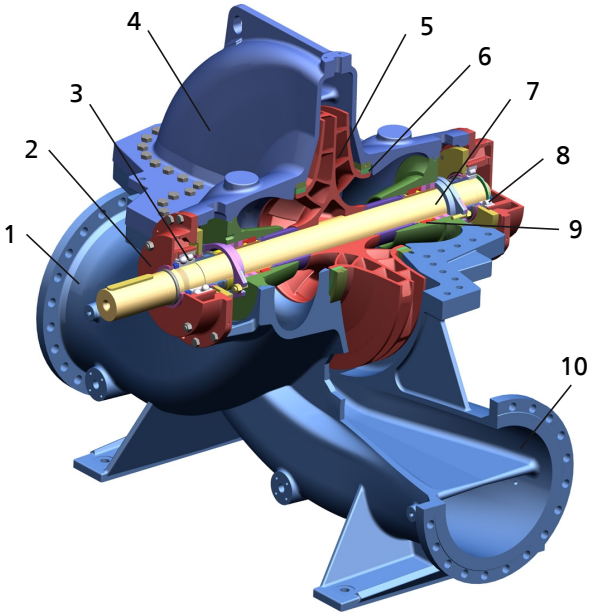

Fig. 3: Sectional drawing

1	Suction nozzle	6	Clearance gap
2	Bearing housing	7	Shaft
3	Rolling element bearing	8	Rolling element bearing
4	Volute casing	9	Shaft seal
5	Impeller	10	Discharge nozzle

Design The pump is designed with a tangential fluid inlet and a tangential fluid outlet. The hydraulic system runs in its own bearings and is connected to the motor by a shaft coupling.

Function The fluid enters the pump tangentially via the suction nozzle (1) and is accelerated outward by the rotating impeller (5). In the flow passage of the pump casing the kinetic energy of the fluid is converted into pressure energy. The fluid is pumped to the discharge nozzle (10), where it leaves the pump. The clearance gap (6) prevents any fluid from flowing back from the casing to the suction nozzle. The shaft (7) enters the hydraulic system through the volute casing (4). The shaft passage through the sealing housing is sealed to atmosphere with a shaft seal (9). The shaft runs in rolling element bearings (3 and 8) located in a bearing housing (2) which is connected to the volute casing (4).

Sealing The pump is sealed by a shaft seal (standardised mechanical seal or gland packing).

4.7 Noise characteristics

Pump **Table 7:** Surface sound pressure level L_{pA} [5)]

Rated power P_N	Surface sound pressure level L_{pA}					
	Pump					
	3500 rpm^{-1}	2900 rpm^{-1}	1750 rpm^{-1}	1450 rpm^{-1}	1160 / 870 rpm^{-1}	960 / 750 rpm^{-1}
[kW]	[dB (A)]	[dB (A)]	[dB (A)]	[dB (A)]	[dB (A)]	[dB (A)]
10	69,5	69,0	67,4	67,0	65,6	64,6
15	70,8	70,3	68,7	68,3	66,9	65,9
20	71,8	71,3	69,7	69,3	67,8	66,8

5 Surface sound pressure level as per ISO 3744 and DIN EN ISO 20361 . valid for a pump operating range of Q/QBEP = 0.8 - 1.1 and non-cavitating operation. If noise levels are to be guaranteed: Add +3 dB for measuring and constructional tolerance. The values indicated do not apply to operation on a frequency inverter.

Rated power P_N	Surface sound pressure level L_{pA}					
	Pump					
	3500 rpm^{-1}	2900 rpm^{-1}	1750 rpm^{-1}	1450 rpm^{-1}	1160 / 870 rpm^{-1}	960 / 750 rpm^{-1}
[kW]	[dB (A)]	[dB (A)]	[dB (A)]	[dB (A)]	[dB (A)]	[dB (A)]
30	73,1	72,7	71,0	70,6	69,1	68,2
40	74,1	73,6	71,9	71,5	70,1	69,1
50	74,8	74,3	72,7	72,2	70,8	69,8
60	75,4	75,0	73,3	72,8	71,4	70,4
70	75,9	75,5	73,8	73,3	71,9	70,9
80	76,4	75,9	74,2	73,8	72,3	71,3
90	76,8	76,3	74,6	74,2	72,7	71,7
100	77,1	76,7	74,9	74,5	73,1	72,1
150	78,5	78,0	76,3	75,8	74,4	73,4
200	79,4	79,0	77,2	76,8	75,3	74,3
250	80,2	79,7	77,9	77,5	76,0	75,0
300	80,8	80,3	78,5	78,1	76,6	75,6
350	81,3	80,8	79,0	78,6	77,1	76,1
400	82,0	81,5	79,8	79,3	77,8	76,8
450	82,1	81,6	79,9	79,4	77,9	76,9
500	82,5	82,0	80,2	79,7	78,3	77,3
600	83,1	82,6	80,8	80,3	78,9	77,8
700	83,6	83,1	81,3	80,8	79,4	78,3
800	84,0	83,6	81,7	81,3	79,8	78,8
900	84,4	84,0	82,1	81,7	80,2	79,2
1000	84,8	84,3	82,5	82,0	80,5	79,5

Pump set **Table 8:** Surface sound pressure level as per ISO 3744 and DIN EN ISO 20361;[6)]

Rated power P_N	Surface sound pressure level as per ISO 3744 and DIN EN ISO 20361;[6)]					
	Pump set					
	3500 rpm^{-1}	2900 rpm^{-1}	1750 rpm^{-1}	1450 rpm^{-1}	1160 / 870 rpm^{-1}	960 / 750 rpm^{-1}
[kW]	[dB (A)]	[dB (A)]	[dB (A)]	[dB (A)]	[dB (A)]	[dB (A)]
10	74,5	74,0	70,0	69,0	66,4	64,6
15	75,7	75,2	71,4	70,5	67,9	66,2
20	76,6	76,1	72,4	71,5	69,0	67,4
30	77,8	77,3	73,8	72,9	70,6	69,0
40	78,7	78,2	74,8	74,0	71,7	70,1
50	79,4	78,9	75,6	74,8	72,6	71,0
60	79,9	79,4	76,3	75,4	73,3	71,8
70	80,4	79,9	76,8	76,0	73,8	72,4
80	80,8	80,3	77,3	76,5	74,4	72,9
90	81,2	80,7	77,7	76,9	74,8	73,4
100	81,5	81,0	78,0	77,2	75,2	73,8
150	82,7	82,2	79,4	78,7	76,8	75,4
200	83,6	83,1	80,4	79,7	77,9	76,6
250	84,3	83,8	81,2	80,5	78,7	77,5
300	84,8	84,3	81,8	81,2	79,4	78,2

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6 Spatial average; as per ISO 3744 and DIN EN ISO 20361; valid for pump operation in the Q/QBEP = 0.8 - 1.1 range and for non-cavitating operation. If noise levels are to be guaranteed: Add +3 dB for measuring and constructional tolerance. The values indicated do not apply to operation on a frequency inverter.

Rated power P_N	Surface sound pressure level as per ISO 3744 and DIN EN ISO 20361;[6)]					
	Pump set					
	3500 rpm^{-1}	2900 rpm^{-1}	1750 rpm^{-1}	1450 rpm^{-1}	1160 / 870 rpm^{-1}	960 / 750 rpm^{-1}
[kW]	[dB (A)]	[dB (A)]	[dB (A)]	[dB (A)]	[dB (A)]	[dB (A)]
350	85,3	84,8	82,4	81,7	80,0	78,8
400	85,7	85,2	82,8	82,2	80,5	79,3
450	86,0	85,6	83,2	82,6	81,0	79,8
500	86,4	85,9	83,6	83,0	81,4	80,2
600	86,9	86,4	84,2	83,7	82,1	81,0
700	87,4	86,9	84,8	84,2	82,7	81,6
800	87,8	87,3	85,2	84,7	83,2	82,1
900	88,2	87,7	85,7	85,1	83,6	82,6
1000	88,5	88,0	86,0	85,5	84,0	83,0

4.8 Scope of supply

Depending on the model, the following items are included in the scope of supply:

- Pump
- Drive
- Baseplate
- Coupling
- Coupling guard
- Universal-joint shaft
- Fasteners for pump and base frame

Optional accessories:

- Vibration monitoring equipment
- Pt100 resistance thermometer
- Pressure gauge
- Measuring nipple for shock pulse measurement
- Cyclone

4.9 Dimensions and weights

For dimensions and weights please refer to the data sheet of the pump (set).

- Pump weight: See name plate of the pump.
- Motor weight: See motor product literature.
- Weight of the shipping unit base frame with pump: See weight indicated on the base frame.
- Weight of the shipping unit base frame with pump and motor: See weight indicated on the base frame.

NOTE

Some individual components weigh more than 25 kg. Check the indicated weights. (⇨ Section 9.1, Page 85) (⇨ Section 1.4, Page 6)

5 Installation at Site

5.1 Safety regulations

For all work involving assembly, reassembly and installation, observe the following safety information:

DANGER

Improper installation in potentially explosive atmospheres

Explosion hazard!

Damage to the pump set!

- Comply with the applicable local explosion protection regulations.
- Observe the information in the data sheet and on the name plates of pump and motor.

DANGER

Improper transport

Risk of injury from lifting heavy components!

- Select lifting accessories which are suitable for the component weight.
- Always use the attachment points provided for the lifting accessories.
- Observe the applicable accident prevention regulations.

5.2 Checks to be carried out prior to installation

Place of installation

WARNING

Installation on a mounting surface which is unsecured and cannot support the load

Personal injury and damage to property!

- Use a concrete of compressive strength class C12/15 which meets the requirements of exposure class XC1 to EN 206.
- The mounting surface must be set, even, and level.
- Observe the weights indicated.

1. Check the structural requirements.
   All structural work required must have been prepared in accordance with the dimensions stated in the outline drawing/general arrangement drawing.

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5.3 Installing the pump set

⚠ WARNING

Hands or foreign objects in the pump casing

Risk of injuries, damage to the pump!

- ▷ Check that the inside of the pump is free from any foreign objects. Remove any foreign objects.
- ▷ Never insert your hands or any other objects into the pump, if the pump set has not been disconnected from the power supply and secured against unintentional start-up.

Depending on the type of installation, several instructions need to be carried out as applicable:

- Prepare and install the base frame/support frame.
- Install the pump and motor on the prepared base frame/support frame.
- Check the alignment of pump and motor.
- Align the pump with the piping.
- Install and align the coupling.
- Connect the piping.
- Perform precision alignment of pump and motor.
- Remove any transport locks.

5.3.1 3E installation

⚠ DANGER

The pump or individual components could slip out of the suspension arrangement

Danger to life from falling parts!

- ▷ Always transport the pump or components in the specified position.
- ▷ Never suspend the pump from its free shaft end.
- ▷ Observe the information given for the individual components regarding weights, centre of gravity and fastening points.
- ▷ Observe the applicable local accident prevention regulations.
- ▷ Use suitable, approved lifting accessories.

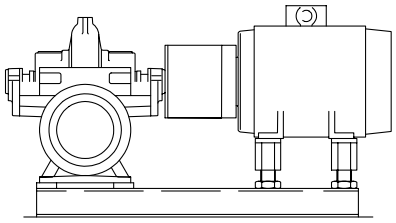

Fig. 4: Pump and motor on a common base frame

Installation with chemical anchor

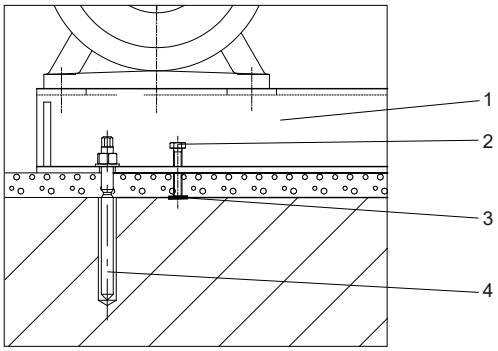

Fig. 5: Installation information: Installation with chemical anchor

1	Base frame, part No. 891	2	Adjusting screw, part No. 901.05
3	Shim, part No. 89-4.03	4	Chemical anchor, part No. 90-3.10

✓ The relevant general arrangement drawing is available.

✓ The foundation has the required strength and characteristics.

✓ The foundation has been prepared in accordance with the dimensions given in the general arrangement drawing.

1. Screw the adjusting screws (2) into the threaded holes provided in the base frame (1).
2. Place the base frame (1) with the inserted adjusting screws (2) on the shims (3). Roughly align the base frame with the piping.
3. Align the pump horizontally using the adjusting screws (2) and a suitable tool (e.g. spirit level) placed on the shaft and discharge nozzle. The maximum permissible deviation is 0.2 mm/m.
4. If the coupling is not fitted, align the pump shaft end with the motor shaft end using the adjusting screws (2) and a straight edge. Tighten the fastening bolts of the pump and motor at the base frame (1).
   If the coupling is fitted, align the pump shaft end with the motor shaft end by using the adjusting screws (2) and placing a straight edge on the coupling. Tighten the fastening bolts of the pump and motor at the base frame (1).
5. Align the pump / base frame assembly with the piping. For lifting and aligning observe the transport instructions. (⇨ Section 3.2, Page 12) The position of the pump on the base frame must not be changed during this alignment.
6. Drill foundation holes in accordance with the chemical anchor dimensions (see table below). Clean the foundation holes.

⚠ WARNING

Improper handling of mortar cartridge

Skin sensitisation and/or irritation!

▹ Wear suitable protective clothing.

7. Insert the mortar cartridges into the drilled holes. Observe the curing times of the mortar cartridges.
8. Insert the threaded bolts of the chemical anchors into the corresponding drilled holes with a suitable tool (e.g. impact drill, hammer drill).
9. Verify the alignment of the pump / base frame assembly with the piping. Re-align it if necessary. For lifting and aligning observe the transport instructions. (⇨ Section 3.2, Page 12) The position of the pump on the base frame must not be changed during this alignment. After the curing time, slightly tighten the chemical anchors (4).

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10. Grout the base frame with quick-setting, low-shrinkage concrete[7)]. Make sure that no cavities remain.
11. When the concrete has set, tighten the chemical anchors with a suitable tool (e.g. torque wrench) (see table below).
12. If the motor was not already mounted when the pump was aligned with the piping, position the motor on the base frame with suitable lifting equipment. Align the shafts with each other. Mount the motor as described in the motor manufacturer's product literature.
13. Connect the piping to the pump without transmitting any stresses or strains. (⇨ Section 5.4, Page 36)
14. Align the coupling as described in the coupling manufacturer's operating manual.

Chemical anchor dimensions

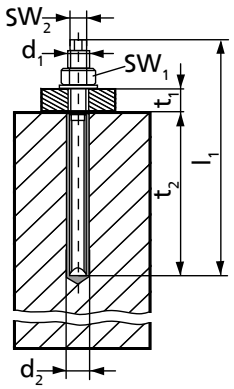

Fig. 6: Dimensions

Table 9: Chemical anchor dimensions

Size	d_2	t_1	t_2	SW_1[8)]	SW_2[8)]	M_{d1}
(d_1 × l_1)	[mm]					[Nm]
M10 × 130	12	22	90	17	6	20
M12 × 160	14	25	110	19	8	40
M16 × 190	18	35	125	24	12	60
M20 × 260	25	65	170	30	14	120
M24 × 300[9)]	28	65	210	36	17	180
M30 × 380[9)]	35	65	280	46	-	400

7 Minimum strength class C25/30
8 SW = Width across flats
9 Mounting accessories of the respective manufacturer are required.

Installation with foundation bolts

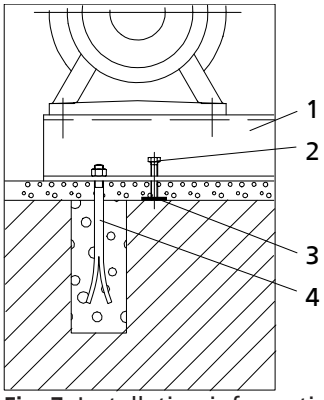

Fig. 7: Installation information: Installation with foundation bolts

1	Base frame, part No. 891	2	Adjusting screw, part No. 901.05
3	Shim, part No. 89-4.03	4	Foundation bolt, part No. 900.01

✓ The relevant general arrangement drawing is available.

✓ The foundation has the required strength and characteristics.

✓ The foundation has been prepared in accordance with the dimensions given in the general arrangement drawing.

1. Screw the adjusting screws (2) into the threaded holes provided in the base frame (1).
2. Insert the foundation bolts (4) into the drilled holes of the base frame (1).
3. Place the shims (3) next to the holes for the foundation bolts (4) in accordance with the general arrangement drawing.
4. Roughly align the base frame (1) (with the foundation bolts (4) inserted and the adjusting screws (2) screwed in) with the piping. Place the base frame on the shims (3).
5. Align the pump horizontally using the adjusting screws (2) and a suitable tool (e.g. spirit level) placed on the shaft and discharge nozzle. The maximum permissible deviation is 0.2 mm/m.
6. If the coupling is not already fitted, align the pump and motor on the base frame by placing a straight edge on the shaft stubs of the pump and motor. Then tighten the fastening bolts. If the coupling is already fitted, align the pump and motor on the base frame by placing a straight edge on the coupling. Then tighten the fastening bolts.
7. Align the pump / base frame assembly with the piping. For lifting and aligning observe the transport instructions. (⇨ Section 3.2, Page 12) The position of the pump on the base frame must not be changed during this alignment.
8. Grout the holes for the foundation bolts with quick-setting, low-shrinkage concrete[7)].
9. When the concrete has set, tighten the foundation bolts evenly until no clearance remains between the nuts and the base frame.
10. Grout the base frame with quick-setting, low-shrinkage concrete[7)]. Make sure that no cavities remain.
11. When the concrete has set, tighten the foundation bolts.
12. If the motor was not already mounted when the pump was aligned with the piping, position the motor on the base frame with suitable lifting equipment. Align the shafts with each other. Mount the motor as described in the motor manufacturer's operating manual.
13. Connect the piping to the pump without transmitting any stresses or strains. (⇨ Section 5.4, Page 36)
14. Align the coupling as described in the coupling manufacturer’s operating manual.

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5.3.2 DJ installation

DANGER

The pump or individual components could slip out of the suspension arrangement

Danger to life from falling parts!

- Always transport the pump or components in the specified position.
- Never suspend the pump from its free shaft end.
- Observe the information given for the individual components regarding weights, centre of gravity and fastening points.
- Observe the applicable local accident prevention regulations.
- Use suitable, approved lifting accessories.

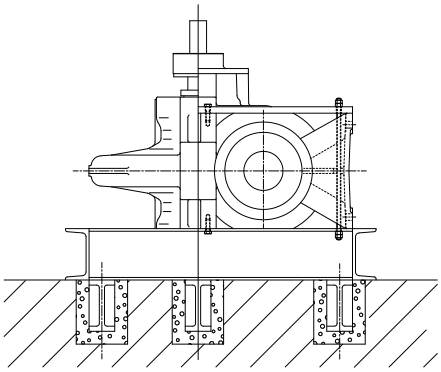

Fig. 8: Pump on its own foot (baseplate), drive on a different construction level

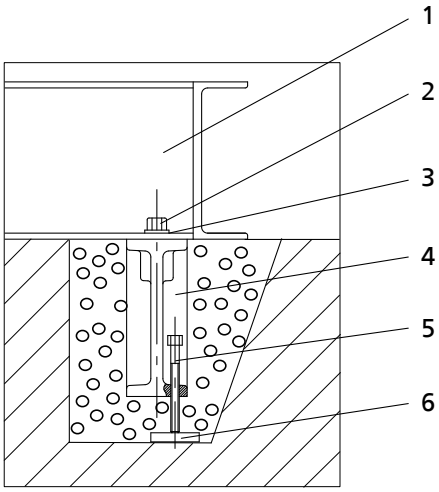

Fig. 9: Installation drawing

1	Foot, part No. 182	2	Hexagon head bolt, part No. 901-11
3	Disc, part No. 550.05	4	Foundation block, part No. 898.01
5	Adjusting screw, part No. 901.10	6	Shim, part No. 89-4.04

✓ The relevant general arrangement drawing is available.

✓ The foundation has the required strength and characteristics.

✓ The foundation has been prepared in accordance with the dimensions given in the general arrangement drawing.

✓ The motor is installed on a separate base frame which is arranged on a higher level in the building in accordance with the motor manufacturer's product literature.

1. Screw the foundation blocks (4) with hexagon head bolts (2) and discs (3) to the foot (1).
2. Screw the adjusting screws (5) into the foundation blocks (4).
3. Place the shim (6) into the recesses for the foundation blocks (4) in accordance with the general arrangement drawing.
4. Place the foot (4) incl. foundation blocks (1) and adjusting screws (5) on the shims (6).
5. Align the pump horizontally using the adjusting screws (2) and a suitable tool (e.g. spirit level) placed on the shaft and discharge nozzle. The maximum permissible deviation is 0.2 mm/m.
6. Align the pump with the piping.
7. Grout the recesses for the foundation blocks with quick-setting, low-shrinkage concrete[10)].
8. When the concrete has set, tighten the hexagon head bolts (2).
9. Connect the piping to the pump without transmitting any stresses or strains. (⇨ Section 5.4, Page 36)

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10 Minimum strength class C25/30

5.3.3 DJ installation with universal-joint shaft

⚠ WARNING

Exposed rotating coupling or universal-joint shaft

Risk of injury by rotating shafts!

- Always operate the pump set with a coupling guard.
  If the customer specifically requests not to include a coupling guard in KSB's delivery, then the operator must supply one!
- Observe all relevant regulations for selecting a coupling guard.

NOTE

If the customer specifically requests not to include a universal-joint shaft guard in our delivery, then the operator must supply one.

For installing and aligning the universal-joint shaft refer to the universal-joint shaft manufacturer's technical product literature.

5.3.4 DB installation and DK installation

⚠ DANGER

The pump or individual components could slip out of the suspension arrangement

Danger to life from falling parts!

- Always transport the pump or components in the specified position.
- Never suspend the pump from its free shaft end.
- Observe the information given for the individual components regarding weights, centre of gravity and fastening points.
- Observe the applicable local accident prevention regulations.
- Use suitable, approved lifting accessories.

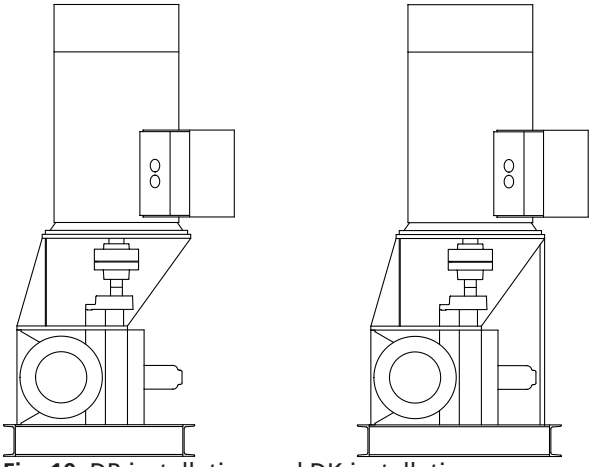

Fig. 10: DB installation and DK installation

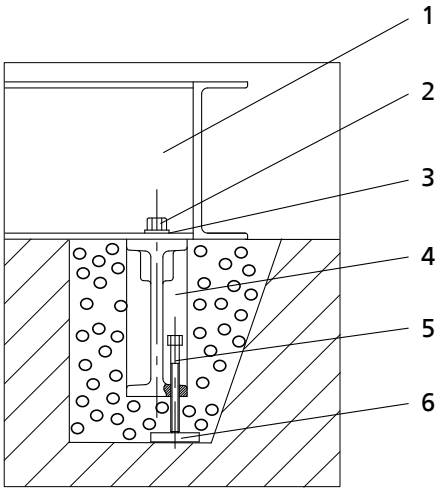

Fig. 11: Installation drawing

1	Foot, part No. 182	2	Hexagon head bolt, part No. 901-11
3	Disc, part No. 550.05	4	Foundation block, part No. 898.01
5	Adjusting screw, part No. 901.10	6	Shim, part No. 89-4.04

✓ The relevant general arrangement drawing is available.

✓ The foundation has the required strength and characteristics.

✓ The foundation has been prepared in accordance with the dimensions given in the general arrangement drawing.

1. Screw the foundation blocks (4) with hexagon head bolts (2) and discs (3) to the foot (1).
2. Screw the adjusting screws (5) into the foundation blocks (4).
3. Place the shims (6) into the recesses for the foundation blocks (4) in accordance with the general arrangement drawing.
4. Place the foot (4) incl. foundation blocks (1) and adjusting screws (5) on the shims (6).
5. Align the pump horizontally in all directions using the adjusting screws (2) and a suitable tool (e.g. spirit level) placed on the machined motor flange of the drive lantern. The maximum permissible deviation is 0.2 mm/m.
6. Align the pump with the piping.
7. Grout the recesses for the foundation blocks with quick-setting, low-shrinkage concrete[11)].
8. When the concrete has set, tighten the hexagon head bolts (2).
9. Connect the piping to the pump without transmitting any stresses or strains. (⇨ Section 5.4, Page 36)
10. Mount the motor on the drive lantern as described in the motor manufacturer's operating instructions.
11. Align the coupling as described in the coupling manufacturer’s operating manual.

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11 Minimum strength class C25/30

5.3.5 DP installation

DANGER

The pump or individual components could slip out of the suspension arrangement

Danger to life from falling parts!

- Always transport the pump or components in the specified position.
- Never suspend the pump from its free shaft end.
- Observe the information given for the individual components regarding weights, centre of gravity and fastening points.
- Observe the applicable local accident prevention regulations.
- Use suitable, approved lifting accessories.

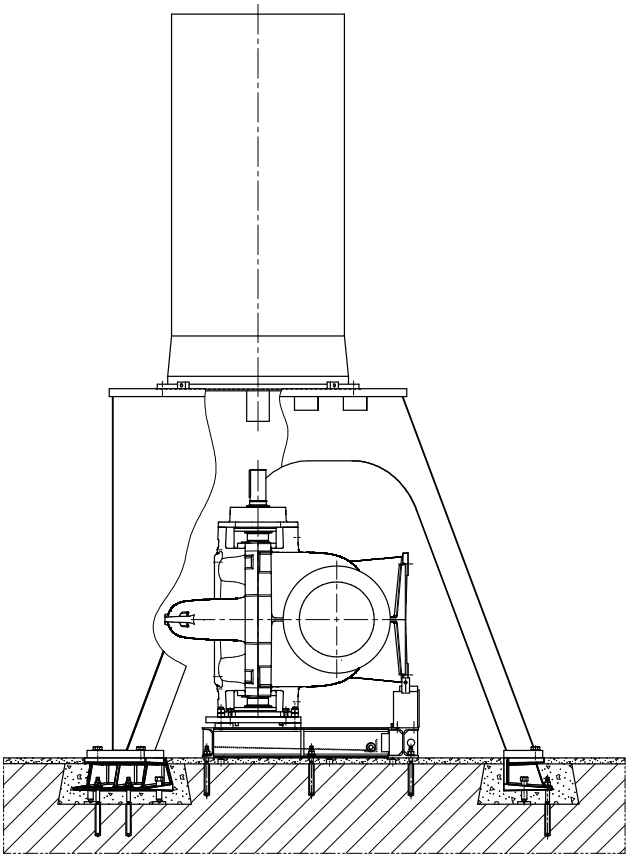

Fig. 12: Pump on foot (baseplate), drive on support frame

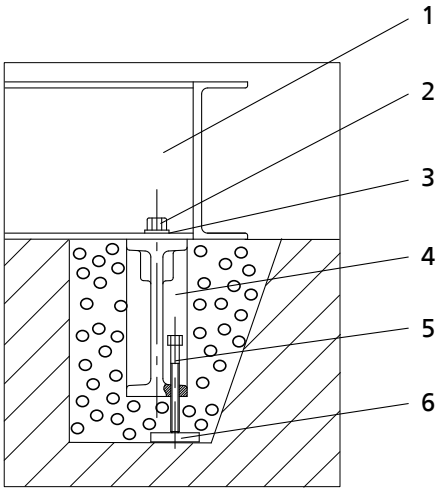

Fig. 13: Installation drawing

1	Foot (baseplate), part No. 182	2	Hexagon head bolt, part No. 901-11
3	Disc, part No. 550.05	4	Foundation block, part No. 898.01
5	Adjusting screw, part No. 901.10	6	Shim, part No. 89-4.04

✓ The relevant general arrangement drawing is available.

✓ The foundation has the required strength and characteristics.

✓ The foundation has been prepared in accordance with the dimensions given in the general arrangement drawing.

1. Screw the foundation blocks (4) with hexagon head bolts (2) and discs (3) to the foot (1).
2. Screw the adjusting screws (5) into the foundation blocks (4).
3. Place the shim (6) into the recesses for the foundation blocks (4) in accordance with the general arrangement drawing.
4. Place the foot (4) incl. foundation blocks (1) and adjusting screws (5) on the shims (6).
5. Align the pump horizontally using the adjusting screws (2) and a suitable tool (e.g. spirit level) placed on the shaft and discharge nozzle. The maximum permissible deviation is 0.2 mm/m.
6. Align the pump with the piping.

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Installation with chemical anchor

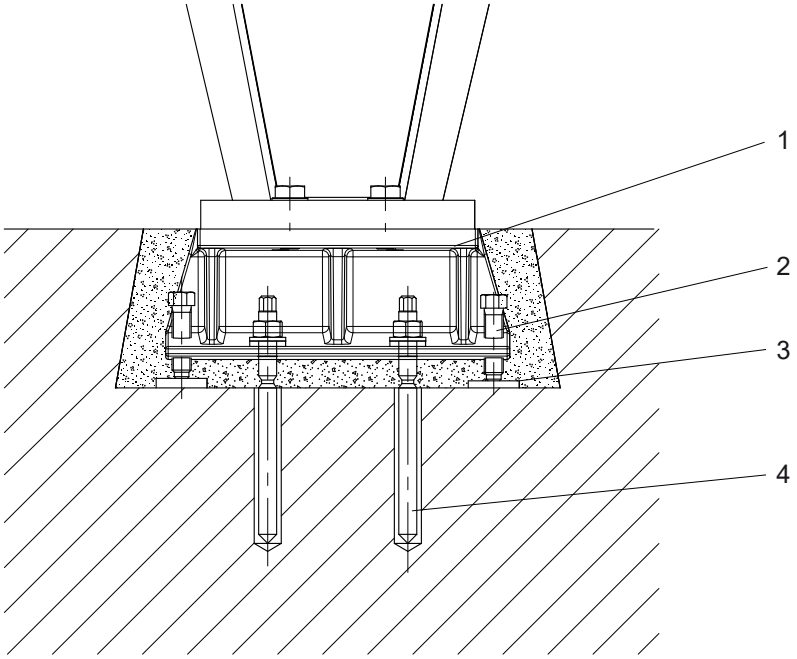

Fig. 14: Installation information: Motor support frame with chemical anchors

1	Foundation rails	2	Levelling screws
3	Shims	4	Chemical anchors

1. Screw the levelling screws (2) into the foundation rails (1) in accordance with the general arrangement drawing.
2. Place the shims (3) into the recesses for the foundation rails (1) in the foundation.
3. Use suitable lifting equipment to place the motor support frame on the foundation together with the pre-assembled foundation rails (1) and levelling screws (2). Vertically position the levelling screws (2) on the shims (3).

DANGER

Unsecured motor

Danger from falling components!

- ▷ Always secure the motor additionally with a crane until the support frame has been completely grouted and the concrete has reached its full strength.

4. Align the motor support frame with the pump. The motor can be fastened to the motor support frame for this purpose. Observe the manufacturer's product literature included with the supplied documentation.
5. Drill foundation holes in accordance with the chemical anchor (4) dimensions (see table below). Clean the foundation holes.

WARNING

Improper handling of mortar cartridge

Skin sensitisation and/or irritation!

- ▷ Wear suitable protective clothing.

6. Insert the mortar cartridges into the drilled holes. Observe the curing times of the mortar cartridges.
7. Insert the threaded bolts of the chemical anchors into the corresponding drilled holes with a suitable tool (e.g. impact drill, hammer drill).

8. Grout the recesses for the foundation rails with quick-setting, low-shrinkage concrete[12)] up to and including the lower edge of the foundation rails. Make sure that no cavities remain.
9. When the concrete has set, tighten the chemical anchors (4) with a suitable tool (e.g. torque wrench) (see table below).
10. Grout the recesses for the foundation rails with quick-setting, low-shrinkage concrete[12)] up to and including the upper edge of the foundation rails.
11. When the concrete has set, the motor can be fastened to the support frame. Observe the motor manufacturer's operating manual.

Final assembly

1. Align the pump on the foot (baseplate) with the motor on the support frame. Align and connect the pump with the piping. (⇨ Section 5.4, Page 36)
2. Grout the recesses for the foundation blocks with quick-setting, low-shrinkage concrete[12)].
3. When the concrete has set, tighten the hexagon head bolts.
4. Connect the piping to the pump without transmitting any stresses or strains. (⇨ Section 5.4, Page 36)
5. Fasten the motor to the support frame in accordance with the general arrangement drawing.
6. Install and align the coupling in accordance with the coupling manufacturer's product literature.

Chemical anchor dimensions

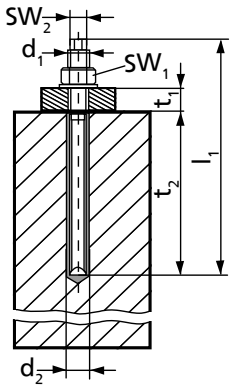

Fig. 15: Dimensions

Table 10: Chemical anchor dimensions

Size	d_2	t_1	t_2	SW_1[13)]	SW_2[13)]	M_{d1}
(d_1 × l_1)	[mm]					[Nm]
M10 × 130	12	22	90	17	6	20
M12 × 160	14	25	110	19	8	40
M16 × 190	18	35	125	24	12	60
M20 × 260	25	65	170	30	14	120
M24 × 300[14)]	28	65	210	36	17	180
M30 × 380[14)]	35	65	280	46	-	400

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12 Refer to the general arrangement drawing for the required concrete quality.
13 SW = Width across flats
14 Mounting accessories of the respective manufacturer are required.

Installation with foundation bolts

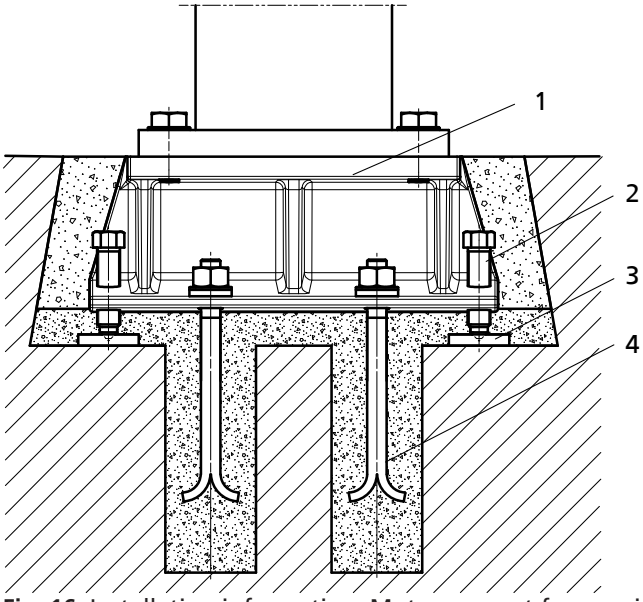

Fig. 16: Installation information: Motor support frame with foundation bolts

1	Foundation rails	2	Levelling screws
3	Shims	4	Foundation bolts

1. Screw the levelling screws (2) into the foundation rails (1) in accordance with the general arrangement drawing.
2. Insert the foundation bolts (4) into the drilled holes of the foundation rails (1).
3. Place the shims (3) into the recesses for the foundation rails (1) in the foundation.
4. Use suitable lifting equipment to place the motor support frame on the foundation together with the pre-assembled foundation rails (1), the levelling screws (2) and the inserted foundation bolts (4). Vertically position the levelling screws (2) on the shims (3).

DANGER

Unsecured motor

Danger from falling components!

- ▷ Always secure the motor additionally with a crane until the support frame has been completely grouted and the concrete has reached its full strength.

5. Align the motor support frame with the pump. The motor can be fastened to the motor support frame for this purpose. Observe the manufacturer's product literature included with the supplied documentation.
6. Grout the holes for the foundation bolts with quick-setting, low-shrinkage concrete[12)] up to and including the lower edge of the foundation rails. Make sure that no cavities remain.
7. When the concrete has set, tighten the foundation bolts.
8. Grout the recesses for the foundation rails with quick-setting, low-shrinkage concrete[12)].
9. When the concrete has set, the motor can be fastened to the support frame. Observe the motor manufacturer’s product literature.

Final assembly

1. Align the pump on the foot (baseplate) with the motor on the support frame. Align and connect the pump with the piping. (⇨ Section 5.4, Page 36)
2. Grout the recesses for the foundation blocks with quick-setting, low-shrinkage concrete[12)].
3. When the concrete has set, tighten the hexagon head bolts (2).
4. Connect the piping to the pump without transmitting any stresses or strains. (⇨ Section 5.4, Page 36)
5. Fasten the motor to the support frame in accordance with the general arrangement drawing.
6. Install and align the coupling in accordance with the coupling manufacturer's product literature.

5.4 Connecting the piping

DANGER

Impermissible loads acting on the pump nozzles

Danger to life from leakage of hot, toxic, corrosive or flammable fluids!

- ▷ Do not use the pump as an anchorage point for the piping.
- ▷ Anchor the pipelines in close proximity to the pump and connect them properly without transmitting any stresses or strains.
- ▷ Observe the permissible forces and moments at the pump nozzles.
- ▷ Take appropriate measures to compensate for thermal expansion of the piping.

CAUTION

Incorrect earthing during welding work at the piping

Destruction of rolling element bearings (pitting effect)!

- ▷ Never earth the electric welding equipment on the pump or baseplate.
- ▷ Prevent current flowing through the rolling element bearings.

NOTE

Installing check and shut-off elements in the system is recommended, depending on the type of plant and pump. However, such elements must not obstruct proper drainage or hinder disassembly of the pump.

- ✓ Suction lift lines have been laid with a rising slope, suction head lines with a downward slope towards the pump.
- ✓ A flow stabilisation section having a length equivalent to at least five times the diameter of the suction flange has been provided upstream of the suction flange.
- ✓ The nominal diameters of the pipes are equal to or greater than the nominal diameters of the pump nozzles.
- ✓ To prevent excessive pressure losses, adapters to larger diameters have a diffuser angle of approx. 8°.
- ✓ The pipelines have been anchored in close proximity to the pump and connected without transmitting any stresses or strains.

1. Thoroughly clean, flush and blow through all vessels, pipelines and connections (especially of new installations).
2. Before installing the pump in the piping, remove any flange covers on the suction and discharge nozzles of the pump.

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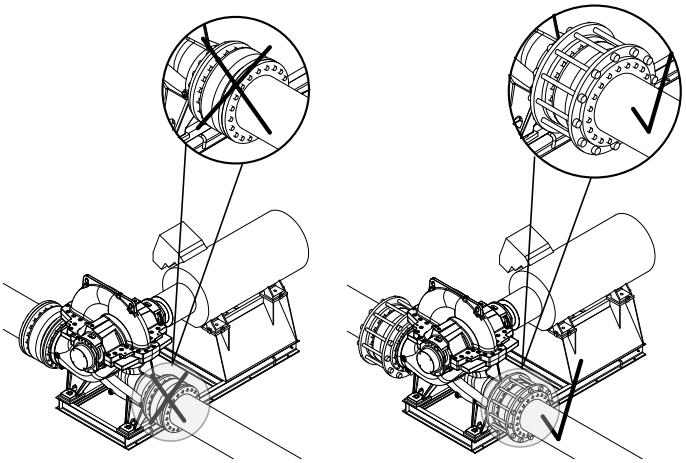

Fig. 17: Connection with expansion joints

	**CAUTION** **Pumps connected with unbraced expansion joints** Machine damage by impermissible nozzle loads! ▷ Never connect the pump with unbraced expansion joints.

3. If the owner/operator supplies an expansion joint, it has to be braced with external tie rods to prevent impermissible nozzle loads.

	**CAUTION** **Weld beads, scale and other impurities in the piping** Damage to the pump! ▷ Remove any impurities from the piping. ▷ If necessary, install a filter. ▷ Observe the information in (⇨ Section 7.2.2.4, Page 61) .

4. If required, install a filter in the piping.
5. Connect the pump nozzles to the piping.

	**CAUTION** **Aggressive flushing liquid and pickling agent** Damage to the pump! ▷ Match the cleaning operation mode and duration of flushing and pickling to the casing materials and seal materials used.

5.5 Enclosure/insulation

	**⚠ WARNING** **Failure to re-install or re-activate protective devices** Risk of injury from moving parts or escaping fluid! ▷ As soon as the work is completed, re-install and/or re-activate any safety-relevant and protective devices.

	**CAUTION** **Heat build-up in the bearing housing** Damage to the bearing! ▷ Never insulate the bearing housing and bearing cover.

5.6 Aligning the pump and motor

	**DANGER** **Inadmissible temperatures at the coupling or bearings due to misalignment of the coupling** Explosion hazard! Risk of burns! ▷ Make sure that the coupling is correctly aligned at all times.

	**CAUTION** **Misalignment of pump and motor shafts** Damage to pump, motor and coupling! ▷ Always check the coupling after the pump has been installed and connected to the piping. ▷ Also check the coupling of pump sets supplied with pump and motor mounted on the same baseplate.

5.6.1 Aligning the motor with adjusting screws

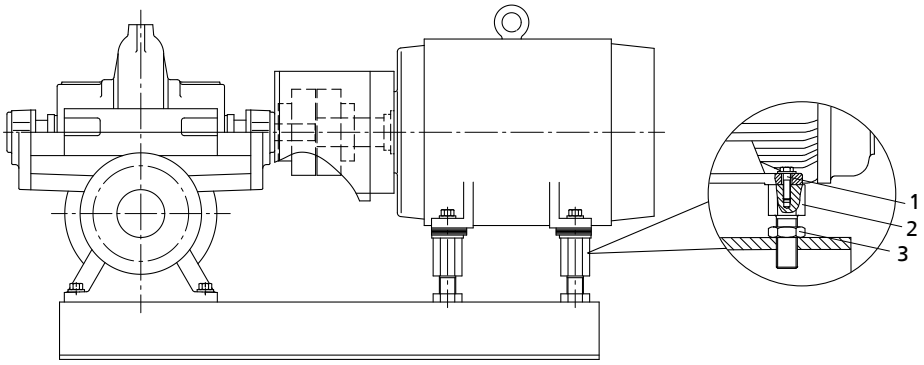

Fig. 18: Aligning the motor with adjusting screws

1	Hexagon head bolt	2	Adjusting screw
3	Locknut		

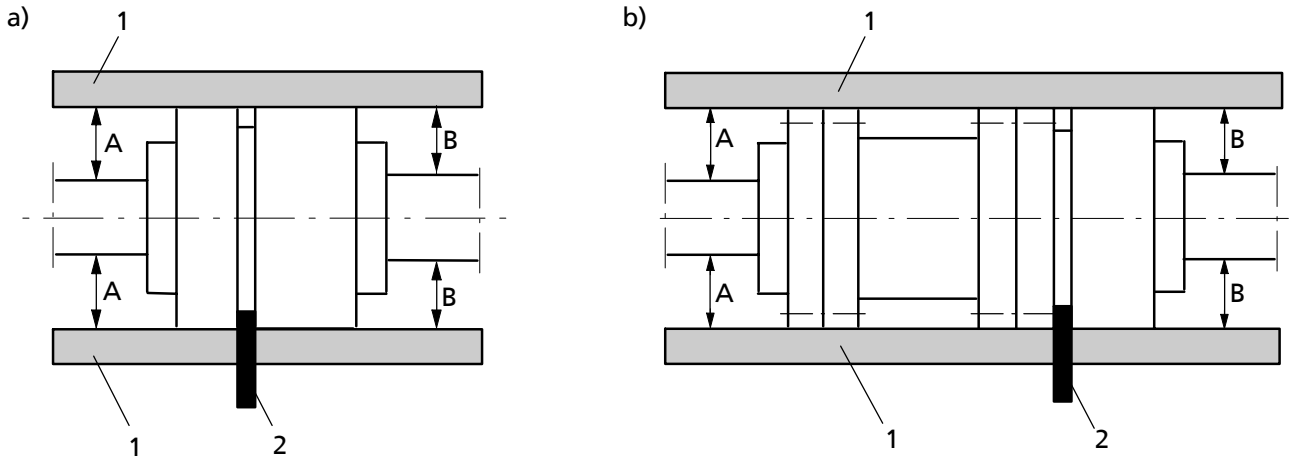

Fig. 19: Checking the coupling alignment: Coupling a) without spacer b) with spacer

1	Straight edge	2	Gauge

✓ The coupling guard and its footboard, if applicable, have been removed.

✓ The manufacturer's product literature for the coupling is available.

1. Place the straight edge (c) axially on both coupling halves.
2. Leave the straight edge (c) in this position and turn the coupling by hand.
   ⇨ The coupling is aligned correctly if the distances A and B to the respective shafts are the same at all points around the circumference. The radial and axial offset between the two coupling halves must not exceed 0.1 mm. Observe the coupling manufacturer's product literature.
3. Unscrew the hexagon head bolts (1) at the motor and the locknuts (3) at the baseplate.
4. Re-adjust the adjusting screws (2) by hand or with a suitable tool (e.g. open-end engineers wrench) until the coupling alignment is correct and all motor feet rest on the baseplate.
5. Re-tighten the hexagon head bolts (1) at the motor and the locknuts (3) at the baseplate.
6. Check proper functioning of coupling/shaft. Check that coupling/shaft can easily be rotated by hand.

⚠ WARNING

Unprotected rotating coupling

Risk of injury by rotating shafts!

- ▹ Always operate the pump set with a coupling guard.
  If the customer specifically requests not to include a coupling guard in KSB's delivery, then the operator must supply one!
- ▹ Observe all relevant regulations for selecting a coupling guard.

⚠ DANGER

Risk of ignition by frictional sparks

Explosion hazard!!

- ▹ Choose a coupling guard material that is non-sparking in the event of mechanical contact.

7. Fit the coupling guard and its footboard if applicable.
8. Check the distance between coupling and coupling guard. The coupling guard must not touch the coupling.

5.6.2 Aligning the motor without adjusting screws

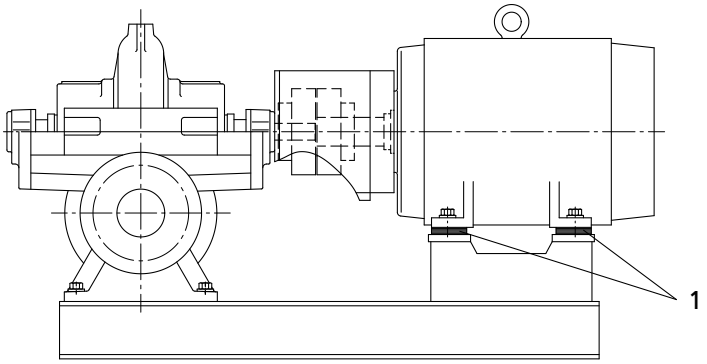

Fig. 20: Aligning the motor without levelling screw

1	Shim

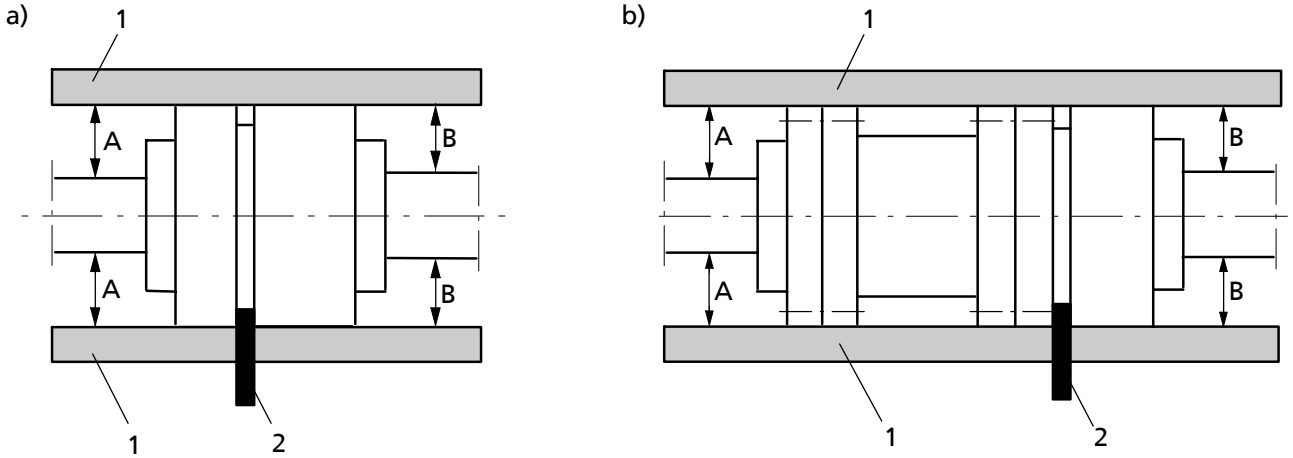

Fig. 21: Checking the coupling alignment: Coupling a) without spacer b) with spacer

1	Straight edge	2	Gauge

✓ The coupling guard and footboard, if any, have been removed.

✓ The manufacturer's product literature for the coupling is available.

1. Place the straight edge (c) axially on both coupling halves.
2. Leave the straight edge (c) in this position and turn the coupling by hand.
   ⇨ The coupling is aligned correctly if the distances A and B to the respective shafts are the same at all points around the circumference. The radial and axial offset between the two coupling halves must not exceed 0.1 mm. Observe the coupling manufacturer's product literature.
3. In case of a misalignment unscrew the hexagon head bolts at the motor.
4. Insert shims (1) underneath the motor feet until the difference in shaft centreline height has been compensated.
5. Re-tighten the hexagon head bolts.
6. Check proper functioning of coupling/shaft. Check that coupling/shaft can easily be rotated by hand.

⚠ WARNING

Unprotected rotating coupling

Risk of injury by rotating shafts!

- ▷ Always operate the pump set with a coupling guard.
  If the customer specifically requests not to include a coupling guard in KSB's delivery, then the operator must supply one!
- ▷ Observe all relevant regulations for selecting a coupling guard.

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	DANGER **Risk of ignition by frictional sparks** Explosion hazard!! ▷ Choose a coupling guard material that is non-sparking in the event of mechanical contact.

7. Re-install the coupling guard and footboard (if any).
8. Check the distance between coupling and coupling guard. The coupling guard must not touch the coupling.

5.7 Permissible forces and moments at the pump nozzles

The resulting permissible forces have been determined according to

$$F_{res} \leq \sqrt{F_x^2 + F_z^2}$$

The forces and moments indicated refer to external, simultaneous loads in 3 dimensions ($F_x = F_y = F_z$ and $M_x = M_y = M_z$). They only apply if the pump set has been properly installed in accordance with the installation/operating manual. The forces and moments in any direction must not exceed the values given in the table. The data on forces and moments apply to static piping loads only. If the limits are exceeded, the values must be checked and verified. The piping must be connected without transmitting any stresses or strains. The pump must not be used as support for the piping. The pump is not an anchorage point for the piping. The piping must be fastened without transmitting any forces, vibrations or pipe weights to the pump. Observe the limits for forces and moments at the suction and discharge nozzle. The pump must not be connected with unbraced expansion joints.

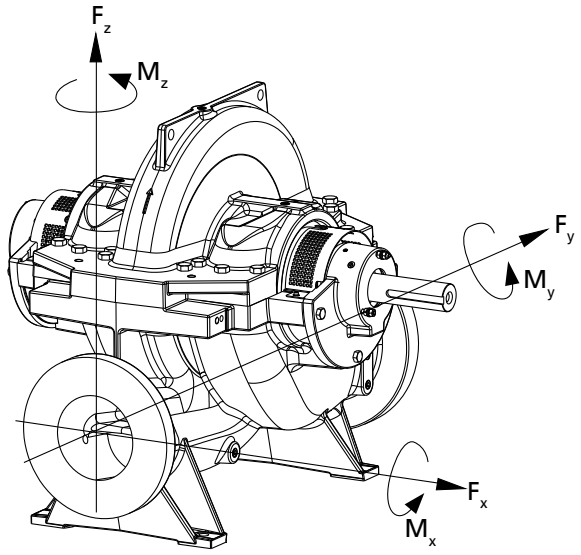

Fig. 22: Flange coordinates

Table 11: Forces and moments at the pump nozzles depending on the material [N/Nm]

Size	Shaft group	Grey cast iron (GB/GC)		Nodular cast iron (SB/SC)		Cast steel (DD_{35})	
		Fx / Fy / Fz	Mx / My / Mz	Fx / Fy / Fz	Mx / My / Mz	Fx / Fy / Fz	Mx / My / Mz
		[N]	[Nm]	[N]	[Nm]	[N]	[Nm]
080-210	I	800	500	1120	700	1520	950
080-270	I	800	500	1120	700	1520	950
080-370	I	800	500	1120	700	1520	950
100-250	I	1000	700	1400	980	1900	1330
100-310	I	1000	700	1400	980	1900	1330

Size	Shaft group	Grey cast iron (GB/GC)		Nodular cast iron (SB/SC)		Cast steel (DD_{35})	
		Fx / Fy / Fz	Mx / My / Mz	Fx / Fy / Fz	Mx / My / Mz	Fx / Fy / Fz	Mx / My / Mz
		[N]	[Nm]	[N]	[Nm]	[N]	[Nm]
100-375	I	1000	700	1400	980	1900	1330
125-230	II	1500	1000	2100	1400	2850	1900
125-290	II	1500	1000	2100	1400	2850	1900
125-365	II	2000	1500	2800	2100	3800	2850
125-500	II	2000	1500	2800	2100	3800	2850
150-290	II	2500	1500	3500	2100	4750	2850
150-360	II	2500	2000	3500	2800	4750	3800
150-460	III	2500	2000	3500	2800	4750	3800
150-605	III	3000	2000	4200	2800	5700	3800
200-320	III	4000	2750	5600	3850	7600	5225
200-330	III	-	-	5600	3850	-	-
200-420	III	4000	2750	5600	3850	7600	5225
200-520	IV	4000	2750	5600	3850	7600	5225
200-670	IV	4000	2750	5600	3850	7600	5225
250-370	IV	4000	2750	5600	3850	7600	5225
250-450	V	-	-	5600	3850	-	-
250-480	V	4000	2750	5600	3850	7600	5225
250-600	V	4000	2750	5600	3850	7600	5225
250-800	VI	4000	2750	5600	3850	7600	5225
300-300	IV	4000	3000	5600	4200	7600	5700
300-435	V	4000	3000	5600	4200	7600	5700
300-560	VI	5000	3000	7000	4200	9500	5700
300-700	VI	5000	3000	7000	4200	9500	5700
300-860	VI	5000	3000	7000	4200	9500	5700
350-360	V	5000	3000	7000	4200	9500	5700
350-430	VI	5000	3000	7000	4200	9500	5700
350-510	VI	5000	3000	7000	4200	9500	5700
400-500	VI	6000	3300	8400	4620	11400	6270

5.8 Auxiliary connections

⚠ WARNING

Screw plugs subjected to pressure

Risk of injuries by parts flying off and escaping fluid!

- ▷ Never use screw plugs for releasing pressure from the pump casing.
- ▷ Always use suitable venting devices (e.g. vent valve).

⚠ WARNING

Failure to use or incorrect use of auxiliary connections (e.g. barrier fluid, flushing liquid, etc.)

Risk of injury from escaping fluid!

Risk of burns!

Malfunction of the pump!

- ▷ Refer to the general arrangement drawing, the piping layout and pump markings (if any) for the quantity, dimensions and locations of auxiliary connections.
- ▷ Use the auxiliary connections provided.

⚠ WARNING

Open pipelines

Risk of injuries by escaping fluid!

Risk of burns!

- ▹ Always close the shut-off valve (e.g. ball valve), if any, with the safety device engaged to prevent it from being opened unintentionally.
- ▹ Guide open pipelines away from the system in such a way that hazards by escaping fluid are prevented.

The pump is supplied with a flushing line fitted at the factory.

The following auxiliary connections are available:

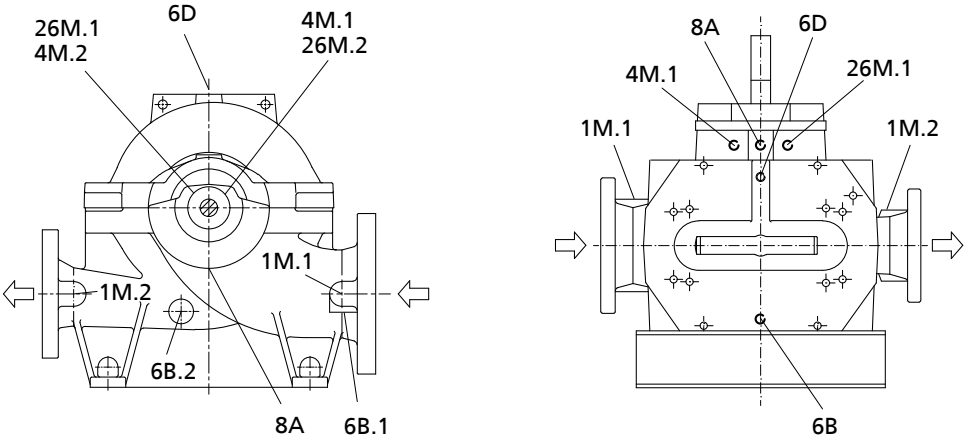

Fig. 23: Auxiliary connections

Table 12: Auxiliary connections

Connection	Description	Type of connection
1M.1	Connection for pressure measurement on the suction side	G 1/2
1M.2	Connection for pressure measurement on the discharge side	G 1/2
4M.1	Connection for temperature measurement at the drive end	G 3/8
4M.2	Connection for temperature measurement at the non-drive end	G 3/8
6B	Connection for pump drain on the suction side	G 1/2
6B.1[15)]	Connection for pump drain on the suction side	G 1/2
6B.2	Connection for pump drain on the discharge side	G 1/2
6D	Connection for venting the pump	G 1/2
8A	Connection for leakage drain	G 3/4
26M.1	Connection for vibration measurement at the drive end	M8
26M.2	Connection for vibration measurement at the non-drive end	M8

15 Applies to sizes 100 - 375, 150 - 290, 150 - 360, 150 - 605, 200 - 420, 200 - 520, 200 - 670, 250 - 600, 250 - 800, 300 - 300, 300 - 435, 300 - 560, 300 - 700, 300 - 860, 350 - 360, 350 - 430, 350 - 510

5.9 Connection to power supply

DANGER

Incorrect electrical installation

Explosion hazard!

- For electrical installation, also observe the requirements of IEC 60079-14.
- Always use a motor protection switch for explosion-proof motors.

DANGER

Electrical connection work by unqualified personnel

Danger of death from electric shock!

- Always have the electrical connections installed by a trained and qualified electrician.
- Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.
- Observe the motor manufacturer's operating instructions.

WARNING

Unintentional starting of the pump set

Risk of injury by moving components and shock currents!

- Ensure that the pump set cannot be started unintentionally.
- Always make sure the electrical connections are disconnected before carrying out work on the pump set.

WARNING

Incorrect connection to the mains

Damage to the power supply network, short circuit!

- Observe the technical specifications of the local energy supply companies.

1. Check the available mains voltage against the data on the motor name plate.
2. Select an appropriate start-up method.

NOTE

Installing a motor protection device is recommended.

5.9.1 Earthing

DANGER

Electrostatic charging

Explosion hazard!

Damage to the pump set!

- Connect the potential equalisation conductor to the earthing terminal provided.
- Make sure that the connection between pump and baseplate is electrically conductive.
- Screws, bolts, nuts and shims must not be coated or the coating must be removed.
- Provide potential equalisation between the pump set and the foundation.

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5.10 Checking the direction of rotation

DANGER

Temperature increase resulting from contact between rotating and stationary components

Explosion hazard!

Damage to the pump set!

- ▹ Never check the direction of rotation by starting up the unfilled pump set.
- ▹ Separate the pump from the motor to check the direction of rotation.

DANGER

Rotating shaft during direction of rotation check

Risk of injury!

- ▹ Maintain a safe distance to the pump set.
- ▹ Comply with the general health and safety regulations.

CAUTION

Drive and pump running in the wrong direction of rotation

Damage to the pump!

- ▹ Refer to the arrow indicating the direction of rotation on the pump.
- ▹ Check the direction of rotation. If required, check the electrical connection and correct the direction of rotation.

✓ The pump has been completely separated from the motor.

✓ All components at the motor (e.g. coupling half at the motor shaft) have been secured.

1. Start the motor and stop it again immediately to determine the motor's direction of rotation.
2. Check the direction of rotation.
   The motor's direction of rotation must match the arrow indicating the direction of rotation on the pump.
3. If the motor runs in the wrong direction of rotation, check the electrical connection of the motor and the control system, if applicable.

5.11 Removing the transport lock

This type of transport lock is only used for vertical pumps with a product-lubricated plain bearing.

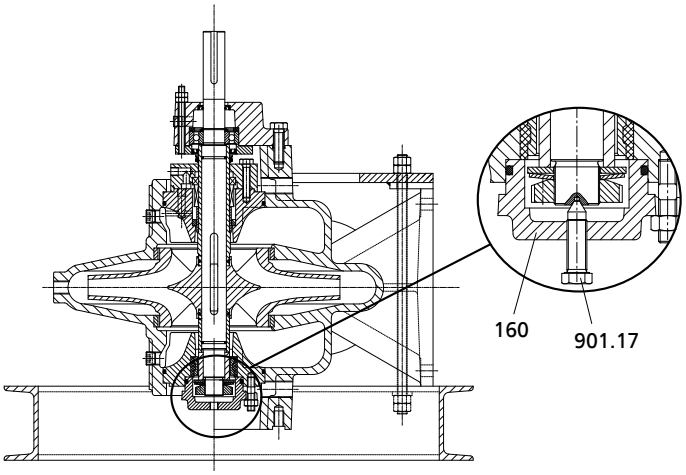

Fig. 24: Transport lock

1. Undo bolt 901.17 at cover 160.
2. Connect a flushing line to the drilled hole in cover 160.

6 Commissioning/Start-up/Shutdown

6.1 Commissioning/Start-up

6.1.1 Prerequisites for commissioning/start-up

Before starting up the pump set make sure that the following requirements are met:

- The pump set has been properly connected to the electric power supply and is equipped with all protection devices. (⇨ Section 5.9, Page 44)
- The pump has been primed with the fluid to be handled.
- The direction of rotation has been checked. (⇨ Section 5.10, Page 45)
- All auxiliary connections required are connected and operational.
- The transport lock has been removed.
- The lubricants have been checked and filled in.
- After prolonged shutdown of the pump (set), the activities described in (⇨ Section 6.4, Page 54) have been carried out.
- The coupling alignment has been checked.

6.1.2 Priming and venting the pump

⚠ DANGER

Formation of a potentially explosive atmosphere inside the pump

Explosion hazard!

- ▷ Before starting up the pump set, vent the pump and suction line and prime both with the fluid to be handled.
- ▷ The fluid for priming the pump must not be combustible.
- ▷ When the fluid for priming the pump is taken from a potentially explosive atmosphere, make sure that no potentially explosive atmosphere can enter the pump.
- ▷ If the pump is in slurp mode, stop the pump immediately.

⚠ DANGER

Shaft seal failure caused by insufficient lubrication

Hot fluid may escape!

- ▷ Before starting up the pump set, vent the pump and suction line and prime both with the fluid to be handled.

1. Close all drains and drain lines.
2. Vent the pump and suction line and prime both with the fluid to be handled. For suction lift operation evacuate the pump.
3. Fully open the shut-off element in the suction line.
4. If the discharge line is equipped with a check valve and back pressure is present, the shut-off element in the discharge line may remain open. If this is not the case, the shut-off element in the discharge line must be closed.
5. Fully open all auxiliary connections (barrier fluid, flushing liquid, etc).

6.1.3 Start-up

DANGER

Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and/or discharge line closed.

Explosion hazard!

Hot or toxic fluids escaping!

- Never operate the pump with the shut-off elements in the suction line and/or discharge line closed.
- Only start up the pump set with the discharge-side shut-off element slightly or fully open.

DANGER

Excessive temperatures due to dry running or excessive gas content in the fluid handled

Explosion hazard!

Damage to the pump set!

- Never operate the pump set without liquid fill.
- Prime the pump as per operating instructions.
- Always operate the pump within the permissible operating range.

WARNING

Pump sets with high noise levels

Damage to hearing!

- Persons must only enter the vicinity of the running pump set if they are wearing protective clothing/ear protection.
- See noise characteristics. (⇨ Section 4.7, Page 19)

CAUTION

Abnormal noises, vibrations, temperatures or leakage

Damage to the pump!

- Switch off the pump (set) immediately.
- Eliminate the causes before returning the pump set to service.

✓ The system piping has been cleaned.

✓ Pump, suction line and inlet tank, if any, have been vented and primed with the fluid to be pumped.

✓ The lines for priming and venting have been closed.

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CAUTION

Start-up against open discharge line

Motor overload!

- ▷ Make sure the motor has sufficient power reserves.
- ▷ Use a soft starter.
- ▷ Use speed control.

1. Fully open the shut-off element in the suction head/suction lift line.
2. Close or slightly open the shut-off element in the discharge line.
3. Start up the motor.
4. Immediately after the pump has reached full rotational speed, slowly open the shut-off element in the discharge line and adjust it to comply with the duty point.

6.1.4 Checking the shaft seal

Mechanical seal

The mechanical seal only leaks slightly or invisibly (as vapour) during operation. Mechanical seals are maintenance-free.

Double mechanical seal

DANGER

Excessive temperature of barrier fluid (pumps with double mechanical seal)

Explosion hazard!

Excessive surface temperature

- ▷ For pumps with double mechanical seal, make sure that the barrier fluid's temperature does not exceed 60 °C.

Gland packing

The gland packing must drip slightly during operation.

DANGER

The temperatures at the gland packing have risen above the permissible limits

Explosion hazard!

- ▷ Gland packings are not approved for use in potentially explosive atmospheres.
- ▷ Immediately switch off the pump set!

The minimum leakage required depends on the fluid handled, pressure, sliding velocity and temperature.

Table 13: Leakage rates at the gland packing

Quantity	Values
Minimum	10 drops/min. (approx. 0.5 ml)
Maximum	120 drops/min. (approx. 6 ml)

CAUTION

Excessive leakage or no leakage at the gland packing

Damage to the pump!

- ▷ Excessive leakage: Re-tighten the gland follower until the required leakage rate is reached.
- ▷ No leakage: Switch off the pump set immediately.
- ▷ It is not recommended to operate pump sets with gland packings in combination with a frequency inverter / variable speed system.

Adjusting the leakage

Prior to commissioning

1. Only lightly tighten the nuts of the gland follower by hand.
2. Use a feeler gauge to verify that the gland follower is mounted centred and at a right angle to the shaft.

⇨ The gland must leak after the pump has been primed.

After five minutes of operation

⚠ WARNING

Unprotected rotating parts

Risk of injury!

- ▹ Do not touch rotating parts.
- ▹ When the pump is running, perform all work with utmost caution.
- ▹ Wear appropriate personal protective equipment.

The leakage can be reduced.

1. Tighten the nuts on the gland follower by 1/6 turn.
2. Monitor the leakage for another five minutes.

Excessive leakage:
Repeat steps 1 and 2 until the minimum value has been reached.

Not enough leakage:
Slightly loosen the nuts at the gland follower.

No leakage:
Immediately switch off pump set!
Loosen the gland follower and repeat commissioning.

Checking the leakage

After the leakage has been adjusted, monitor the leakage for about two hours at maximum fluid temperature.
Check that enough leakage occurs at the gland packing at minimum fluid pressure.

6.1.5 Shutdown

CAUTION

Backflow of the fluid handled

Motor or winding damage!

Excessive reverse runaway speed of the motor!

- ▹ Observe the permissible reverse runaway speed of the motor. See the manufacturer's product literature included with the supplied documentation.
- ▹ Close the shut-off elements.

✓ The shut-off element in the suction line is and remains open.

1. Close the shut-off element in the discharge line.
2. Switch off the motor and make sure the pump set runs down smoothly to a standstill.

NOTE

If the discharge line is equipped with a non-return or check valve, the shut-off element may remain open provided that the system conditions and system regulations are considered and observed.

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For prolonged shutdown periods:

1. Close the shut-off element in the suction line.
2. Close the auxiliary connections.

CAUTION

Risk of freezing during prolonged pump shutdown periods

Damage to the pump!

- ▷ Drain the pump and the cooling/heating chambers (if any) or otherwise protect them against freezing.

6.2 Operating limits

DANGER

Non-compliance with operating limits for pressure, temperature, fluid handled and speed

Explosion hazard!

Hot or toxic fluid could escape!

- ▷ Comply with the operating data specified in the data sheet.
- ▷ Never use the pump for handling fluids it is not designed for.
- ▷ Avoid prolonged operation against a closed shut-off element.
- ▷ Never operate the pump at temperatures, pressures or rotational speeds exceeding those specified in the data sheet or on the name plate unless the written consent of the manufacturer has been obtained.

DANGER

Formation of a potentially explosive atmosphere inside the pump

Explosion hazard!

- ▷ When draining tanks take suitable measures to prevent dry running of the pump (e.g. fill level monitoring).

6.2.1 Maximum operating pressure

CAUTION

Permissible operating pressure exceeded

Damage to connections and seals!

- ▷ Never exceed the operating pressure specified in the data sheet.

The maximum operating pressure depends on the pump size, pump material and nominal pressure of the flange design.
Neither the material/size-dependent maximum pressure indicated in the data sheet nor the maximum nominal flange pressure must be exceeded.

6.2.2 Hydraulic operating range

	CAUTION
	Non-compliance with hydraulic operating limits Damage to the pump and motor ▷ Observe the limits in the data sheet. ▷ Brief passage through the critical range below Q_{min} is permissible during start-up.

General information on the hydraulic operating range

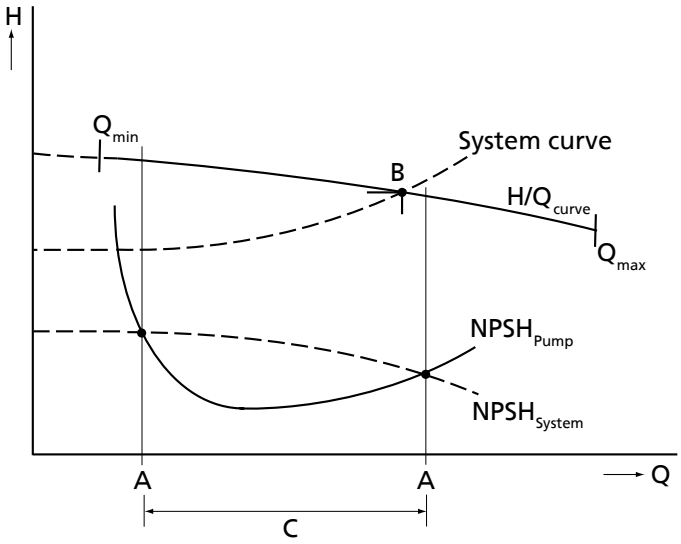

Fig. 25: Pump operating range

$NPSH_{Available}$	Inlet pressure available in the system	$NPSH_{Required}$	Required inlet pressure
A	Operating limit	B	Operating point
C	Operating range without NPSH margin		

The flow rate Q will develop automatically as a function of the discharge head H, in line with the pump's characteristic curve. The pump's permissible operating range has limits that are independent of each other in terms of their cause.

Part load operating limit
This limit is indicated in the H/Q characteristic by Q_{min} or by discontinuation of the characteristic curve in the diagram.

NPSH-related limits under off-design conditions
The part load and overload limits are determined by the ratio of $NPSH_{Required}$ to $NPSH_{Available}$.
The NPSH limits are determined as follows:
The intersections of $NPSH_{Required}$ and $NPSH_{Available}$ are projected onto the H/Q characteristic, where they represent the operating limits.

If the pump set is operated outside its operating limits or system-related changes occur, check the NPSH values.
If necessary, consult your nearest customer service centre.

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6.2.3 Frequency of starts

DANGER

Excessive surface temperature of the motor

Explosion hazard!

Damage to the motor!

- In case of explosion-proof motors, observe the frequency of starts specified in the manufacturer's product literature.

CAUTION

Re-starting while motor is still running down

Damage to the pump (set)!

- Do not re-start the pump set before the pump rotor has come to a standstill.

The frequency of starts is usually determined by the maximum temperature increase of the motor. This largely depends on the power reserves of the motor in steady-state operation and on the starting conditions (DOL, star-delta, moments of inertia, etc).
Observe the motor manufacturer's operating instructions.

6.2.4 Fluid handled

6.2.4.1 Temperature of the fluid handled

CAUTION

Fluid temperature too high or too low

Damage to the pump!

- Never operate the pump set against a closed shut-off element.
- Never operate the pump at temperatures above or below those specified in the data sheet or on the name plate unless the written consent of the manufacturer has been obtained.

If the values are not indicated in the data sheet, the following temperature limits apply. The temperatures must neither be below nor above these limits.

Table 14: Temperature limits of the fluid handled

Minimum fluid temperature	0 °C
Maximum fluid temperature	+ 80 °C

6.2.4.2 Abrasive fluids/solids

CAUTION

Abrasive particles or solids in the fluid

Damage to the pump!

- Comply with the limits indicated in the data sheet.
- Flush the piping prior to commissioning.
- Install a filter in the system, if required.

Do not exceed the maximum permissible solids content specified in the data sheet. When the pump handles fluids containing abrasive substances, increased wear of the hydraulic system and shaft seal are to be expected. In this case, reduce the commonly recommended inspection intervals.

NOTE

Solids, especially long fibres, plastic residues or similar, can lead to clogging of the barrier or flushing lines and to mechanical seal damage.

6.3 Shutdown/storage/preservation

CAUTION

Corrosion caused by stagnant aggressive fluids, e.g. fluids containing chloride

Damage to the pump!

- ▹ Every 24 hours operate the pump for a minimum of 30 minutes or flush it with clean, pure water.[16)]

The pump (set) remains installed

✓ Sufficient fluid is supplied for the functional check run of the pump.

1. For prolonged shutdown periods, start up the pump (set) regularly between once a month and once every three months for approximately five minutes.
   ⇨ This will prevent the formation of deposits within the pump and the pump intake area.

The pump (set) is removed from the pipe and stored

✓ The pump has been properly drained. (⇨ Section 7.3, Page 62)

✓ The safety instructions for dismantling the pump have been observed.

✓ The permissible ambient temperature for storing the pump is observed.

1. Spray-coat the inside wall of the pump casing and, in particular, the impeller clearance areas with a preservative.
2. Spray the preservative through the suction nozzle and discharge nozzle.
   It is advisable to then close the pump nozzles (e.g. with plastic caps).
3. Oil or grease all exposed machined parts and surfaces of the pump (with silicone-free oil and grease, food-approved, if required) to protect them against corrosion.
   Observe the additional instructions on preservation. (⇨ Section 3.3, Page 14)

6.4 Returning to service

For returning the equipment to service, observe the sections on commissioning/start-up (⇨ Section 6.1, Page 47) and the operating limits (⇨ Section 6.2, Page 51) .

In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇨ Section 7, Page 55)

⚠ WARNING

Failure to re-install or re-activate protective devices

Risk of injury from moving parts or escaping fluid!

- ▹ As soon as the work is completed, properly re-install and re-activate any safety-relevant devices and protective devices.

NOTE

On pumps/pump sets older than 5 years we recommend replacing all elastomer seals.

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16 E.g. drinking water or demineralised water

7 Servicing/Maintenance

7.1 Safety regulations

DANGER

Sparks produced during servicing work

Explosion hazard!

- Observe the safety regulations in force at the place of installation!
- Always perform maintenance work on explosion-proof pump sets outside potentially explosive atmospheres.

DANGER

Improperly serviced pump set

Explosion hazard!

Damage to the pump set!

- Service the pump set regularly.
- Prepare a maintenance schedule with special emphasis on lubricants, shaft seal and coupling.

DANGER

Excessive temperatures due to dry running

Explosion hazard!

Fire hazard!

Damage to the pump set!

- Never operate the pump set without liquid fill.
- Never close the shut-off element in the suction line and/or supply line during pump operation.

DANGER

Excessive temperatures as a result of bearings running hot or defective bearing seals

Explosion hazard!

Fire hazard!

Damage to the pump set!

- Regularly check the rolling element bearings for running noises.

The operator ensures that maintenance, inspection and installation are performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.

WARNING

Unintentional starting of the pump set

Risk of injury by moving components and shock currents!

- Ensure that the pump set cannot be started unintentionally.
- Always make sure the electrical connections are disconnected before carrying out work on the pump set.

WARNING

Fluids handled, consumables and supplies which are hot and/or pose a health hazard

Risk of injury!

- Observe all relevant laws.
- When draining the fluid take appropriate measures to protect persons and the environment.
- Decontaminate pumps which handle fluids posing a health hazard.

WARNING

Insufficient stability

Risk of crushing hands and feet!

- During assembly/dismantling, secure the pump (set)/pump parts to prevent tilting or tipping over.

A regular maintenance schedule will help avoid expensive repairs and contribute to trouble-free, reliable operation of the pump, pump set and pump parts with a minimum of servicing/maintenance expenditure and work.

NOTE

All maintenance work, service work and installation work can be carried out by KSB Service or authorised workshops. Find your contact in the attached Addresses booklet or visit https://www.ksb.com/en-global/contact.

Never use force when dismantling and reassembling the pump set.

7.2 Servicing/inspection

7.2.1 Supervision of operation

DANGER

Risk of potentially explosive atmosphere inside the pump

Explosion hazard!

- The pump internals in contact with the fluid to be handled, including the seal chamber and auxiliary systems, must be filled with the fluid to be handled at all times.
- Provide sufficient inlet pressure.
- Provide an appropriate monitoring system.

DANGER

Excessive temperatures as a result of bearings running hot or defective bearing seals

Explosion hazard!

Fire hazard!

Damage to the pump set!

Risk of burns!

- Regularly check the lubricant level.
- Regularly check the rolling element bearings for running noises.

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DANGER

Excessive temperatures due to dry running

Explosion hazard!

Fire hazard!

Damage to the pump set!

- ▷ Never operate the pump set without liquid fill.
- ▷ Never close the shut-off element in the suction line and/or supply line during pump operation.

CAUTION

Impermissibly high temperature of fluid handled

Damage to the pump!

- ▷ Prolonged operation against a closed shut-off element is not permitted (heating up of the fluid).
- ▷ Observe the temperature limits in the data sheet and in the section on operating limits. (⇨ Section 6.2, Page 51)

CAUTION

Corrosion caused by stagnant aggressive fluids, e.g. fluids containing chloride

Damage to the pump!

- ▷ Every 24 hours operate the pump for a minimum of 30 minutes or flush it with clean, pure water.[17)]

While the pump is in operation, observe and check the following:

- The pump must run quietly and free from vibrations at all times.
- Check the shaft seal. (⇨ Section 6.1.4, Page 49)
- Check the static sealing elements for leakage.
- Check the rolling element bearings for running noises.
  Vibrations, noise and an increase in current input occurring during unchanged operating conditions indicate wear.
- Monitor the correct functioning of any auxiliary connections.
- Monitor the stand-by pump.
  To make sure that stand-by pumps are ready for operation, start them up once a week.
- Monitor the bearing temperature.
  The bearing temperature must not exceed 90 °C (measured on the outside of the bearing bracket).
- Check the flexible elements of the coupling and replace them, if required.
- Check any pressure gauges.
- Check the drive as described in the manufacturer's product literature.
- Check that the fitted coupling guard does not touch the coupling.
- Make sure that the earthing connection has been fitted and marked.

17 E.g. drinking water or demineralised water

CAUTION

Operation outside the permissible bearing temperature

Damage to the pump!

- ▷ The bearing temperature of the pump (set) must never exceed 90 °C (measured on the outside of the bearing bracket).

NOTE

After commissioning, increased temperatures may occur at grease-lubricated rolling element bearings due to the running-in process. The final bearing temperature is only reached after a certain period of operation (up to 48 hours depending on the conditions).

7.2.1.1 Warning values and cut-out values

As an option, the pump can be fitted with various sensors. If such sensors are fitted, observe the following warning values and cut-out values:

Table 15: Warning values and cut-out values

Sensors	Warning value	Cut-out value
Vibrations [18] for pumps with a drive rating < 200 kW [mm/s rms]	6,4[19]	10,6
Vibrations [20] for pumps with a drive rating > 200 kW [mm/s rms]	7,6[21]	11,9
Bearing temperature at the outer bearing ring [°C]	85	90

7.2.2 Inspection work

DANGER

Excessive temperatures caused by friction, impact or frictional sparks

Explosion hazard!

Fire hazard!

Damage to the pump set!

- ▷ Regularly check the coupling guard, plastic components and other guards of rotating parts for deformation and sufficient distance from rotating parts.

DANGER

Electrostatic charging due to insufficient potential equalisation

Explosion hazard!

- ▷ Make sure that the connection between pump and baseplate is electrically conductive.

18 To DIN ISO 10816-7, category II, zone A

19 Within the preferred operating range of 0.7 ≤ Q/QBEP ≤ 1.2 the vibration values of newly commissioned pumps with good system conditions (piping layout, approach flow at the pump, etc.) are below the boundary of zone A to DIN ISO 10816-7, i.e. below 3.2 mm/s rms.

20 To DIN ISO 10816-7, category II, zone A

21 Within the preferred operating range of 0.7 ≤ Q/QBEP ≤ 1.2 the vibration values of newly commissioned pumps with good system conditions (piping layout, approach flow at the pump, etc.) are below the boundary of zone A to DIN ISO 10816-7, i.e. below 4.2 mm/s rms.

7.2.2.1 General information

Check and service all components of the pump set as described in the corresponding operating manuals provided by the manufacturers.
For the manufacturer's product literature see other applicable documents.

7.2.2.2 Routine maintenance and inspection intervals

Table 16: Routine maintenance and inspection intervals

Interval	Number of persons	Time	Maintenance task
Daily	1	6 min.	▪ Check the leakage at the mechanical seal or the leakage rate at the gland packing.
Weekly	1	15 min.	▪ Check the pump operation (inlet pressure, head, bearing temperature, noises and vibrations).
Monthly	1	15 min.	▪ Verify the torsional clearance of the coupling (see operating instructions of the coupling).
	1	15 min.	▪ Switch to a stand-by pump, if any, or carry out a functional check run (5 minutes).
Every 20,000 operating hours	2	3 h	▪ Replace the rolling element bearings.
Every 4 years or if discharge head drops	2	6 h	▪ Generally inspect and overhaul the pump in accordance with the operating instructions. ▪ Check and replace, if necessary: – bearings, casing wear ring, impeller wear ring, shaft protecting sleeve – impeller and shaft – Fit new sealing elements.

7.2.2.3 Checking the clearances

NOTE

The maximum clearances are based on an efficiency loss of approximately 3 % compared to the clearances of the pump in as-new condition.

Excessive clearances will affect pump performance. Losses in efficiency and discharge head will occur.

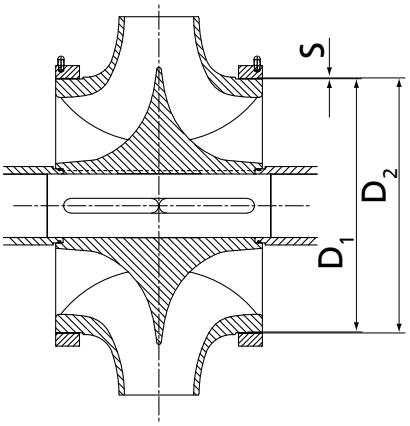

Fig. 26: Impeller, clearance

1. Remove the pump rotor. (⇨ Section 7.4.4, Page 68)
2. Checking the clearances If the clearance is larger than permitted, replace the casing wear ring and impeller wear ring.

Table 17: Clearances

Size	Maximum permissible nominal clearance (wear limit)	Minimum clearance	Maximum clearance
	$\frac{D_2 - D_1}{2}$	S_{min}	$S_{max.}$
	[mm]	[mm]	[mm]
80-210	0,3	0,15	0,2
80-270	0,3	0,15	0,2
80-370	0,3	0,15	0,2
100-250	0,35	0,17	0,2
100-310	0,35	0,17	0,2
100-375	0,35	0,17	0,2
125-230	0,35	0,18	0,23
125-290	0,35	0,18	0,23
125-365	0,35	0,18	0,23
125-500	0,35	0,18	0,23
150-290	0,45	0,22	0,26
150-360	0,45	0,22	0,26
150-460	0,45	0,22	0,26
150-605	0,45	0,22	0,26
200-320	0,5	0,24	0,28
200-330	0,5	0,25	0,29
200-420	0,5	0,24	0,28
200-520	0,5	0,24	0,28
200-670	0,5	0,24	0,28
250-370	0,5	0,24	0,28

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Size	Maximum permissible nominal clearance (wear limit)	Minimum clearance	Maximum clearance
	$\frac{D_2 - D_1}{2}$	S_{min}	$S_{max.}$
	[mm]	[mm]	[mm]
250-450	0,5	0,24	0,28
250-480	0,5	0,24	0,28
250-600	0,5	0,24	0,28
250-800	0,5	0,24	0,28
300-300	0,5	0,24	0,28
300-435	0,6	0,29	0,35
300-560	0,6	0,29	0,35
300-700	0,6	0,29	0,35
300-860	0,6	0,29	0,35
350-360	0,5	0,24	0,28
350-430	0,6	0,32	0,37
350-510	0,6	0,32	0,37
400-500	0,6	0,32	0,37

7.2.2.4 Cleaning filters

CAUTION

Insufficient inlet pressure due to clogged filter in the suction line

Damage to the pump!

- ▷ Monitor contamination of filter with suitable means (e.g. differential pressure gauge).
- ▷ Clean filter at appropriate intervals.

7.2.2.5 Lubricating the rolling element bearings

DANGER

Excessive temperatures as a result of bearings running hot or defective bearing seals

Explosion hazard!

Fire hazard!

Damage to the pump set!

- ▷ Regularly check the bearing seals.

CAUTION

Temporary storage of the pump set too long

Formation of deposits or condensate, resinification or leakage of grease!

- ▷ Replace the complete rolling element bearings before returning the pump set to service.

CAUTION

Pump stored too long or incorrectly

Damage to the pump!

- ▷ Check especially the rolling element bearings and the lubricant. If any damage is suspected, replace the rolling element bearings.

The rolling element bearings are supplied greased for life. No re-lubrication is required.

7.3 Drainage/cleaning

⚠ WARNING

Fluids handled, consumables and supplies which are hot and/or pose a health hazard

Hazard to persons and the environment!

- ▷ Collect and properly dispose of flushing fluid and any fluid residues.
- ▷ Wear safety clothing and a protective mask if required.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

If the pump set has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump set must be neutralised, and anhydrous inert gas must be blown through the pump to ensure drying.

Use connection 6B to drain the fluid handled (see drawing of auxiliary connections).

7.4 Dismantling the pump set

7.4.1 General information/Safety regulations

⚠ DANGER

Insufficient preparation of work on the pump (set)

Risk of injury!

- ▷ Properly shut down the pump set.
- ▷ Close the shut-off elements in the suction line and discharge line.
- ▷ Drain the pump and release the pump pressure. (⇨ Section 7.3, Page 62)
- ▷ Shut off any auxiliary feed lines.
- ▷ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Unqualified personnel performing work on the pump (set)

Risk of injury!

- ▷ Always have repair work and maintenance work performed by specially trained, qualified personnel.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

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⚠ WARNING

Unintentional starting of the pump set

Risk of injury by moving components and shock currents!

- ▷ Ensure that the pump set cannot be started unintentionally.
- ▷ Always make sure the electrical connections are disconnected before carrying out work on the pump set.

⚠ WARNING

Hot surface

Risk of injury!

- ▷ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Components with sharp edges

Risk of cutting or shearing injuries!

- ▷ Always use appropriate caution for installation and dismantling work.
- ▷ Wear work gloves.

Observe the general safety instructions and information. (⇨ Section 2.7, Page 9)

For any work on the motor, observe the instructions of the relevant motor manufacturer.

For dismantling and reassembly refer to the general drawing.

In the event of damage you can always contact our service departments.

7.4.2 Preparing the pump set

⚠ DANGER

The pump (set) could slip out of the suspension arrangement

Danger to life from falling parts!

- ▷ Always transport the pump (set) in the specified position.
- ▷ Never attach the suspension arrangement to the free shaft end or the motor eyebolt.
- ▷ Observe the information about weights, centre of gravity and fastening points.
- ▷ Observe the applicable local accident prevention regulations.
- ▷ Use suitable, permitted lifting accessories, e.g. self-tightening lifting tongs.

NOTE

Horizontal installation

The pumps have been designed in such a way that the complete rotor can be removed and dismantled without the need to remove the suction and discharge line and without disturbing the alignment of the pump set.

NOTE

Vertical installation

For dismantling a vertically installed pump, the complete pump has to be removed and placed in a horizontal position. Then, the complete rotor can be removed and dismantled.

Preparing for dismantling

- ✓ The gate valves in the suction and discharge lines have been closed.
- ✓ The motor has been disconnected from the power supply and secured against unintentional start-up.
- ✓ The pump has been drained.

1. Remove the flushing line and any auxiliary feed lines connected to the pump.
2. Remove the coupling guard and any other guards.
3. Separate the pump from the motor.

Removing vertically installed pumps in DJ installation

DJ installation

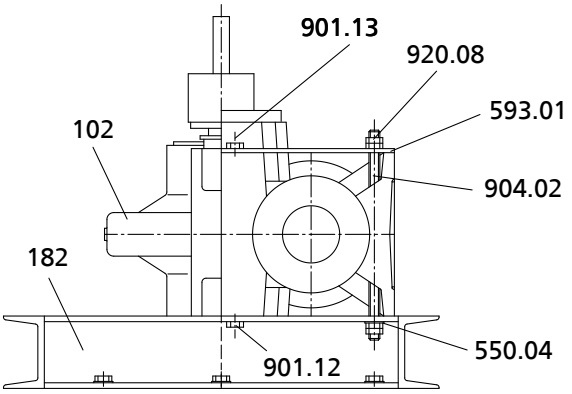

Fig. 27: DJ installation

- ✓ Lifting equipment of suitable dimensions for the indicated component weights is available.
- ✓ The gate valves in the suction and discharge lines have been closed.
- ✓ The motor has been disconnected from the power supply and secured against unintentional start-up.
- ✓ The pump has been drained.
- ✓ Any auxiliary feed lines have been removed.
- ✓ The pump has been separated from the motor.

1. Undo the connecting elements between the pump flanges and the pipes.
2. Suspend volute casing 102 from the lifting equipment and secure it.
3. Undo screwed connection 901.13/920.08 between the pump and rail 593.01. Remove the rail.
4. Remove stud 904.02.
5. Undo screwed connection 901.12 between the pump and foot 182. Lift up the pump and place it down in a horizontal position on a suitable surface.

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Removing vertically installed pumps in DB installation

DB installation

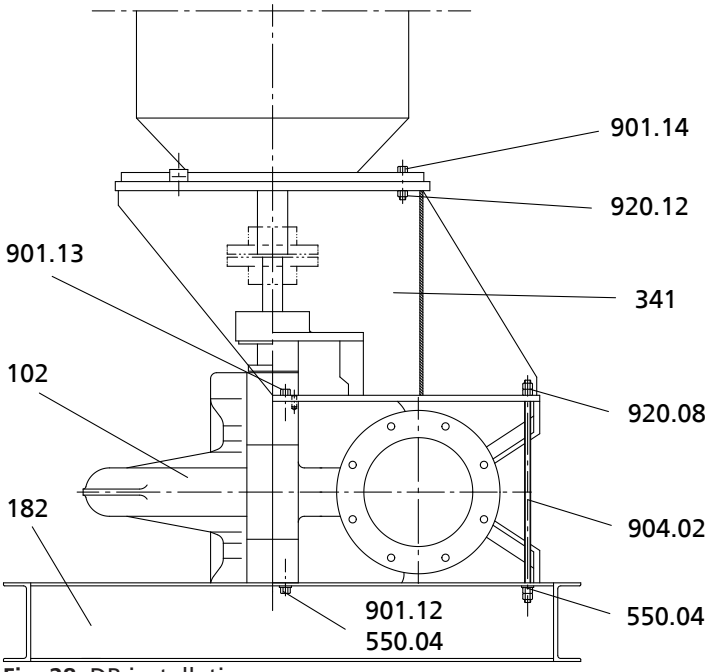

Fig. 28: DB installation

- ✓ Lifting equipment of suitable dimensions for the indicated component weights is available.
- ✓ The gate valves in the suction and discharge lines have been closed.
- ✓ The motor has been disconnected from the power supply and secured against unintentional start-up.
- ✓ The pump has been drained.
- ✓ Any auxiliary feed lines have been removed.
- ✓ The pump has been separated from the motor.

1. Undo screwed connection 901.14/920.12 between the motor and drive lantern 341.
2. Use suitably dimensioned lifting equipment to lift up the motor and place it on a suitable surface.
3. Suspend drive lantern 341 from the lifting equipment and secure it.
4. Undo screwed connection 901.13/920.08 between drive lantern 341 and the pump. Lift up drive lantern 341 and place it down on a suitable surface.
5. Undo the connecting elements between the pump flanges and the pipes.
6. Remove stud 904.02.
7. Suspend volute casing 102 from the lifting equipment and secure it.
8. Undo screwed connection 901.12 between the pump and foot 182. Lift up the pump and place it down in a horizontal position on a suitable surface.

Removing vertically installed pumps in DK installation

DK installation

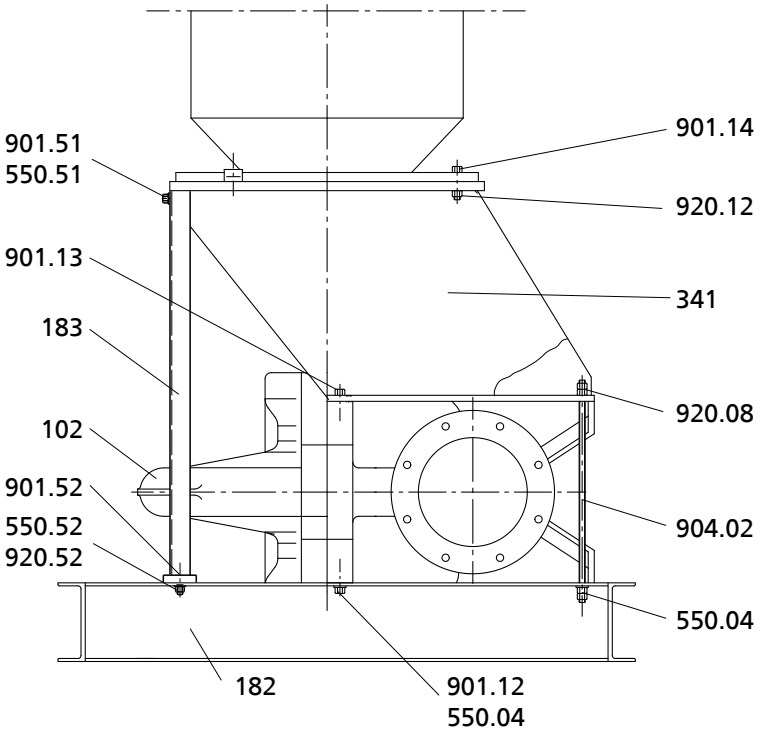

Fig. 29: DK installation

- ✓ Lifting equipment of suitable dimensions for the indicated component weights is available.
- ✓ The gate valves in the suction and discharge lines have been closed.
- ✓ The motor has been disconnected from the power supply and secured against unintentional start-up.
- ✓ The pump has been drained.
- ✓ Any auxiliary feed lines have been removed.
- ✓ The pump has been separated from the motor.

1. Undo screwed connection 901.14/920.12 between the motor and drive lantern 341.
2. Use suitably dimensioned lifting equipment to lift up the motor and place it on a suitable surface.
3. Suspend drive lantern 341 from the lifting equipment and secure it.
4. Undo screwed connection 901.51 between drive lantern 341 and support foot 183. Undo screwed connection 901.52/920.52 between support foot 183 and foot 182.
5. Undo screwed connection 901.13/920.08 between drive lantern 341 and the pump. Lift up drive lantern 341 and place it down on a suitable surface.
6. Undo the connecting elements between the pump flanges and the pipes.
7. Remove stud 904.02.
8. Suspend volute casing 102 from the lifting equipment and secure it.
9. Undo screwed connection 901.12 between the pump and foot 182. Lift up the pump and place it down in a horizontal position on a suitable surface.

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Removing vertically installed pumps in DP installation

DP installation

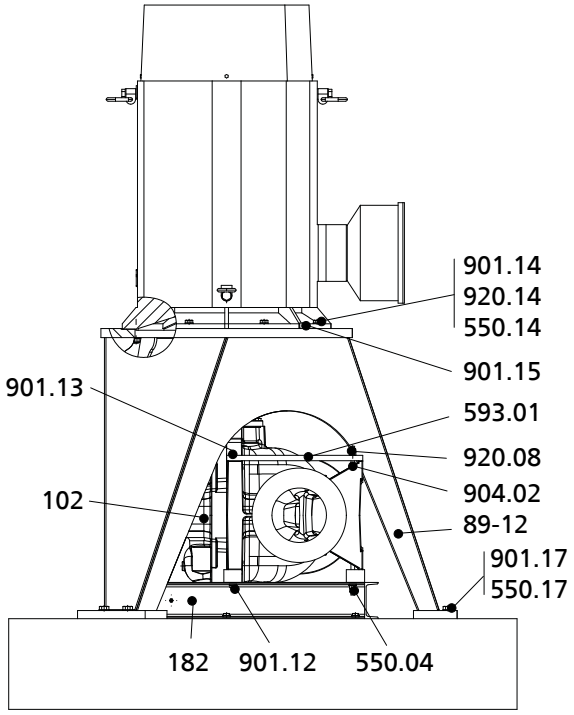

Fig. 30: DP installation

- ✓ Lifting equipment of suitable dimensions for the indicated component weights is available.
- ✓ The gate valves in the suction and discharge lines have been closed.
- ✓ The motor has been disconnected from the power supply and secured against unintentional start-up.
- ✓ The pump has been drained.
- ✓ Any auxiliary feed lines have been removed.
- ✓ The pump has been separated from the motor.

1. Undo the connecting elements between the motor and motor bracket 89-12.
2. Use suitably dimensioned lifting equipment to lift up the motor and place it on a suitable surface.
3. Secure the motor bracket. Undo the connecting elements 901.17 of the motor bracket. Remove motor bracket 89-12.
4. Undo the connecting elements between the pump flanges and the pipes.
5. Suspend volute casing 102 from the lifting equipment and secure it.
6. Undo screwed connection 901.13/920.08 between the pump and rail 593.01. Remove the rail.
7. Remove stud 904.02.
8. Undo screwed connection 901.12 between the pump and foot 182. Lift up the pump and place it down in a horizontal position on a suitable surface.

7.4.3 Opening the volute casing

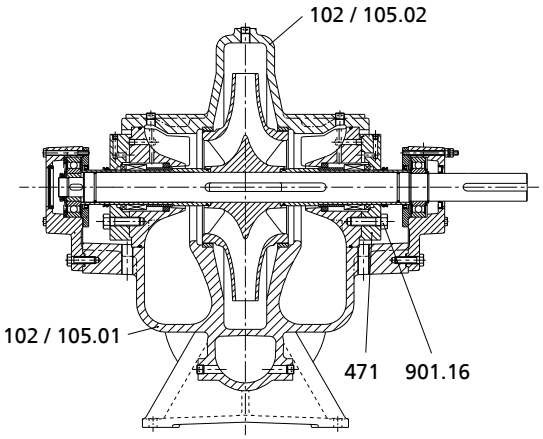

Fig. 31: Opening the volute casing

✓ The pump has been placed in a horizontal position on a solid and level surface.

✓ Suitably dimensioned lifting equipment is available.

1. Suspend volute casing 102 from the lifting equipment and secure it.
2. Undo screwed connections 901.16 at seal cover 471[22)] and slide back the seal cover.
3. Remove bolts 901.1/901.02 from the casing split flange. Separate upper casing half 105.02 from lower casing half 105.01 with forcing screws and lift it off with lifting equipment. Take care to lift the upper part up straight without tilting it.
4. Place the upper part of volute casing 105.02 on a clean assembly surface.

7.4.4 Removing the rotor

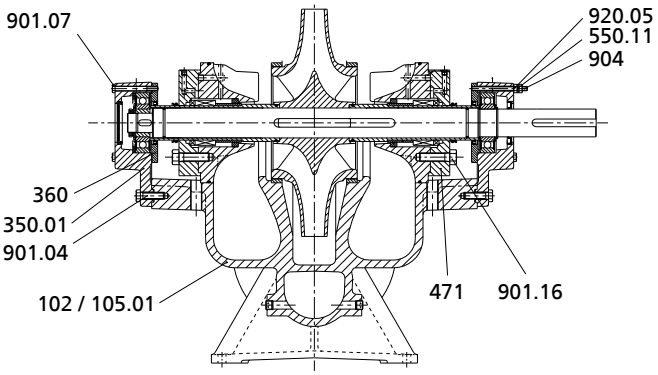

Fig. 32: Removing the rotor

✓ The upper section of the volute casing has been removed.

✓ Suitably dimensioned lifting tackle is available.

1. Undo screwed connection 901.4 between bearing housing 350.1 and the bearing brackets. Undo screwed connection 901.07 / 920.05 for fastening bearing cover 360.
2. Press the bearing housing out of the centring hub of the volute casing. Use suitable lifting equipment, e.g. looped ropes, to lift the rotor out of the lower casing half and securely place it down in a horizontal position.

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22 Only for mechanical seal

7.4.5 Dismantling the rotor

Dismantling the rotor of a horizontally installed pump

✓ The rotor has been placed on a clean assembly surface and secured against rolling off.

✓ The general assembly drawing is available.

1. Dismantle the pump-end coupling half.
2. Pull off the bearing housing of the fixed bearing (opposite the drive end).
3. Remove slotted round nut 920.03.
4. Take deep groove ball bearing 312 with bush 520 off the shaft.
5. Remove bearing cover 360.
6. Pull V-ring 411.01 off the shaft protecting sleeve.
7. Remove seal cover 471 with the mating ring of the mechanical seal.
8. Pull off shaft protecting sleeve 524.01 with mechanical seal 433.
9. Remove shaft seal housing 441.
10. Impeller 234 sits on the shaft with a sliding fit. Normally, it can be removed easily. If the impeller is hard to remove, it can be loosened by gently tapping the hub with a wooden mallet.
11. If applicable, remove the complete second shaft protecting sleeve 524.01 with shaft seal housing 441 and shaft seal ring.
12. Pull off bearing housing 350.01.
13. Remove circlip 932 and pull off deep groove ball bearing 321.

Dismantling the rotor of a vertically installed pump

✓ The rotor has been placed on a clean assembly surface and secured against rolling off.

✓ The general assembly drawing is available.

1. Dismantle the pump-end coupling half.
2. Undo nuts 920.02. Remove bearing cover 160. Then remove locknut 920.01, disc springs 950 and disc 550.03.
3. Remove bearing housing 350.02, shaft protecting sleeve 524.02, bearing bush 545 and spacer sleeve 525.
4. Impeller 234 sits on the shaft with a sliding fit. Normally, it can be removed easily. If the impeller is hard to remove, it can be loosened by gently tapping the hub with a wooden mallet.
5. Pull off shaft seal housing 441 with the shaft seal and shaft protecting sleeve 524.01.
6. Remove nuts 920.05, bearing housing 350.01 with spacer ring 550.02 and circlip 932 as well as spacer ring 550.01.
7. Pull off bearing cover 360 and deep groove ball bearing 321.

7.5 Reassembling the pump set

7.5.1 General information/Safety regulations

DANGER

The pump (set) could slip out of the suspension arrangement

Danger to life from falling parts!

- Always transport the pump (set) in the specified position.
- Never attach the suspension arrangement to the free shaft end or the motor eyebolt.
- Observe the information about weights, centre of gravity and fastening points.
- Observe the applicable local accident prevention regulations.
- Use suitable, permitted lifting accessories, e.g. self-tightening lifting tongs.

WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

WARNING

Unqualified personnel performing work on the pump (set)

Risk of injury!

- Always have repair work and maintenance work performed by specially trained, qualified personnel.

WARNING

Unintentional starting of the pump set

Risk of injury by moving components and shock currents!

- Ensure that the pump set cannot be started unintentionally.
- Always make sure the electrical connections are disconnected before carrying out work on the pump set.

WARNING

Components heated up for installation

Risk of burns to hands!

- Wear protective gloves suitable for installation work.
- Let components cool down after installation.

CAUTION

Improper reassembly

Damage to the pump!

- Reassemble the pump (set) in accordance with the general rules of sound engineering practice.
- Use original spare parts only.

Always observe the safety instructions and information. (⇨ Section 2.7, Page 9)

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For any work on the motor, observe the instructions of the relevant motor manufacturer.

For dismantling and reassembly, refer to the general assembly drawing.

In the event of damage, you can always contact our service department.

Sequence

Always reassemble the pump in accordance with the corresponding general assembly drawing and installation instructions.

O-rings/V-rings

- Never use O-rings that have been made by cutting an O-ring cord to size and gluing the ends together.
- Replace all O-rings and V-rings and clean their seats on the shaft. Place all sealing elements into their seats in the relevant components before assembling the components.

Tension spring

- Remove the tension spring (2) of shaft seal ring 421.02.

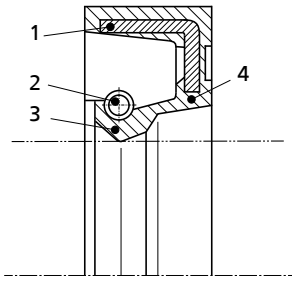

Fig. 33: Removing the tension spring

1	Metal insert	2	Tension spring
3	Sealing lip	4	Elastomer component

Assembly adhesives

- Observe the installation instructions regarding cleaning, lubricating and sealing agents.
- Remove any residues of liquid sealants prior to assembly.
- Coat the locating surfaces of the individual components and screwed connections with graphite or similar before reassembly.

Tightening torques

For reassembly, tighten all screws and bolts as specified in this manual.

7.5.2 Installing the rotor

✓ Suitably dimensioned lifting equipment is available.

✓ The pump shaft has been placed down in a horizontal position on a level and clean assembly surface and secured against rolling off.

✓ The corresponding general assembly drawing and installation instructions are available.

1. The locating surfaces, threads and sliding fits of pump shaft 211 have been cleaned. Assembly paste has been applied in accordance with the installation instructions.
2. Fit keys into the keyways of pump shaft 211.
3. Fit impeller 234. **Check that the direction of rotation of the impeller is correct!**

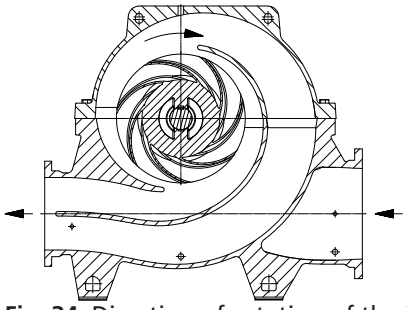

Fig. 34: Direction of rotation of the impeller

NOTE

Looking onto the shaft from the drive end
Suction nozzle left = direction of rotation left (anti-clockwise)
Suction nozzle right = direction of rotation right (clockwise)
Watch the vane position of the impeller!

4. Fit the wear rings on the running surfaces of the impeller. Make sure that the chamfered side of the rings is facing outwards (facing the bearing). Fit the studs required to hold the wear rings in position.
5. Slide shaft protecting sleeves 524.01 onto pump shaft 211. Make sure that the key of the impeller is engaged in the keyway provided.

7.5.2.1 Installing the mechanical seal

Pump set with KSB mechanical seal

✓ The individual parts have been placed in a clean and level assembly area.
✓ All dismantled parts have been cleaned and checked for wear.
✓ Any damaged or worn parts have been replaced by original spare parts.
✓ The sealing surfaces have been cleaned.

1. Slide shaft seal housing 441 onto the shaft.
2. Slide the sub-assembly of rotating components of the mechanical seal (torque-transmitting element, springs, primary ring, secondary seal, etc.) onto shaft protecting sleeve 524.01 as far as it will go.
3. Tighten grub screws with cup point evenly, alternately and gradually to the torques specified, depending on the nominal thread diameter.
   Grub screws with cup point may be used without applying a thread-locking agent. Grub screws with cup point must not be re-used.

Table 18: Tightening torques for grub screws with cup point

Thread	Tightening torque [Nm]
M6	8
M8	15
M10	20

CAUTION

Incorrect position of the mechanical seal
Hot fluid or steam may spurt out during operation!
▷ Make sure the mechanical seal is seated properly.

4. Slide shaft protecting sleeve 524.01 with the shaft seal ring onto the shaft.
5. Insert the mating ring with the corresponding O-ring into the seal cover (see general assembly drawing). A lubricant can be applied to the O-ring. Press it in evenly. Make sure the contact faces are dry.
6. Fit seal cover 471 with the mating ring.

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Pump set with standardised mechanical seal

1. Pull spacer sleeve 525.02 onto shaft protecting sleeve 524.01.
2. Slide shaft seal housing 441 onto the shaft and install the mechanical seal as described in the manufacturer's operating instructions.
3. Slide the complete rotating assembly onto the shaft protecting sleeve. Observe the installation dimension given in the installation drawing of the mechanical seal or slide it further until it abuts against the spacer sleeve. Then tighten the grub screws firmly and secure them with LOCTITE.
4. Insert the mating ring with the corresponding O-ring into the seal cover (see general assembly drawing). A lubricant can be applied to the O-ring. Press it in evenly. Make sure the contact faces are dry.
5. Fit seal cover 471 with the mating ring.

7.5.2.2 Fitting the gland packing

✓ The gland packing chamber is clean and free from any packing residues.

✓ The shaft protecting sleeve has a bright metal surface which is free from score marks. If required, the shaft protecting sleeve has been replaced.

1. Slide shaft seal housing 441 onto shaft protecting sleeve 524.1.
2. Use stuffing box insert 455 to tamp down the individual packing rings in the gland packing chamber. Insert subsequent packing rings one at a time, with their joints staggered at 90°-180°. Refer to the general assembly drawing for the number of rings and the position of neck ring 457 or lantern ring 458, if applicable. Preferably use compression-moulded packing rings.
3. Position gland follower 452 and tighten it lightly to allow the packing rings in the gland packing chamber to adjust.
4. Loosen the gland follower to relieve the load on the packing.

7.5.2.3 Installing the bearings

⚠ WARNING

Components heated up for installation

Risk of burns to hands!

- ▹ Wear protective gloves suitable for installation work.
- ▹ Let components cool down after installation.

Horizontal installation

Installing the drive-end bearing

✓ The impeller has been fitted.

✓ The shaft seal has been fitted.

✓ The corresponding general assembly drawing and installation manuals are available.

1. Slide bearing cover 360 with inserted lip seal 421.02 (for explosion-proof version labyrinth ring 423.02) on shaft protecting sleeve 524.
2. Heat up deep groove ball bearing 321 and pull it onto pump shaft 211. Prevent any one-sided pressure and impacts. Secure the bearing with disc 550.01 and circlip 932.

Installing the non-drive end bearing

✓ The impeller has been fitted.

✓ The shaft seal has been fitted.

✓ The corresponding general assembly drawing and installation manuals are available.

1. Slide bearing cover 360 with inserted lip seal 421.02 (for explosion-proof version labyrinth ring 423.02) on shaft protecting sleeve 524.
2. Heat up deep groove ball bearing 321 and fit it onto sleeve 520.
3. Slide sleeve 520 with deep groove ball bearing 321 onto pump shaft 211 with key 940.01 inserted.
4. Load the rotor parts elastically by means of slotted round nut 920 and disc spring 950. For this purpose, compress disc spring 950 to blocking point and then undo slotted round nut 920 again by half a turn (180°).
5. Fit both shaft seal housings 441. Make sure that the guide vanes point vertically upwards.
   For shaft unit DW 60[23], DW 80[24], DW 90[25] and DW 120[26] fit both shaft seal housings 441. Make sure that the guide vanes are positioned at an upward angle of 45° off the horizontal in extension of the suction nozzle.

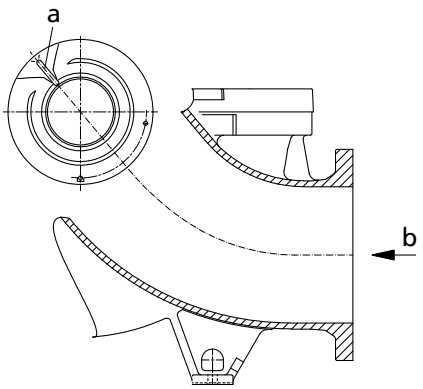

Fig. 35: Position of the guide vane for shaft units DW 90 and DW 120

a	Guide vane at the shaft seal housing	b	Suction nozzle

Vertical installation with plain bearing

✓ The impeller has been fitted.

✓ The shaft seal has been fitted.

✓ The corresponding general assembly drawing and installation manuals are available.

1. Install non-drive end spacer sleeve 525 like shaft protecting sleeve 524.01.
2. Pull on shaft protecting sleeve 524.02. Fit bearing housing 350.02 incl. bearing bush 545 and O-ring 412.1.
3. Fasten shaft protecting sleeve 524.02 to the shaft with disc 550.03, disc spring 950 and nut 920.01.

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23 Applies to the following sizes only: 200-330

24 Applies to the following sizes only: 250-450

25 Applies to the following sizes only: 250-800, 300-560, 300-700, 350-430, 350-510 and 400-500

26 Applies to the following sizes only: 300-860

4. Load the rotor parts elastically by means of slotted round nut 920 and disc spring 950. For this purpose, compress disc spring 950 to blocking point and then undo slotted round nut 920 again by half a turn (180°).
5. Fit bearing cover 160.
6. Fit both shaft seal housings 441. Make sure that the guide vanes point vertically upwards.
   For shaft unit DW 60[23)], DW 80[24)], DW 90[25)] and DW 120[26)] fit both shaft seal housings 441. Make sure that the guide vanes are positioned at an upward angle of 45° off the horizontal in extension of the suction nozzle.

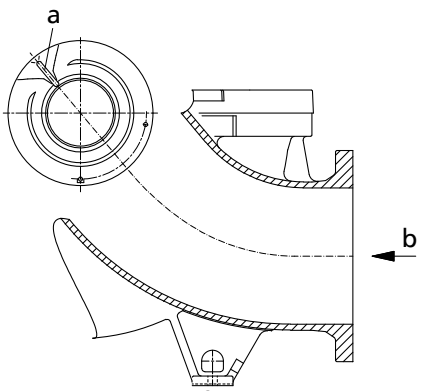

Fig. 36: Position of the guide vane

a	Guide vane at bearing housing 350.2	b	Suction nozzle

7.5.2.4 Final installation of the rotor

✓ The rotor has been assembled.
✓ The direction of rotation of the impeller has been verified.
✓ The position of the guide vanes of the shaft seal housing 441 and/or bearing housing 350.02 has been verified.
✓ The corresponding general assembly drawing and installation instructions are available.

1. Apply Loctite 574 to the contact faces of the casing wear ring and the seal housing.
2. Insert the rotor. Observe the direction of rotation.
3. Align the rotor. Make sure that the fastening studs are correctly inserted into the pump casing.
4. Observe the position of pins 561.01.

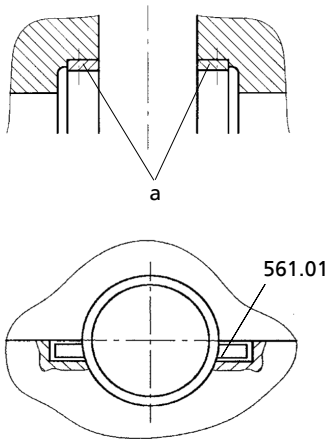

Fig. 37: Position of pins 561.01

a	Casing wear rings		

5. Slide bearing housing 350.01 with inserted discs 550.02/.03[27] over deep groove ball bearings 321.
6. Screw bearing housing 350.01 to the bearing brackets with bolted connections 901.04. Their locations are determined by the centring recesses.
7. Fit the bearing cover.
8. Apply Loctite 5203 to the contact face of the lower casing section.
9. Tighten the bolts at the casing split flange diagonally, starting with the bolts nearest the volute.
10. Insert the key for the coupling into pump shaft 211.
11. Install the coupling in accordance with the manufacturer's operating instructions.

7.5.3 Mounting the pump set on the baseplate

Type of installation 3E

Refer to the corresponding sections on how to install the pump set.
(⇨ Section 5.3, Page 23)

Type of installation DJ, DB and DK

✓ Suitably dimensioned lifting tackle is available.

✓ The corresponding general assembly drawing and/or installation instructions are available.

✓ The pump has been completely assembled.

1. Use lifting equipment to lift up the pump, position it vertically and place it on foot 182 (base frame).
2. Tighten screwed connection 901.12 between pump 655 and foot 182.
3. Use lifting equipment to lift drive lantern 341 and position it on the pump. Align drive lantern 341 with locking sleeve 531.01. Tighten screwed connection 901.13 / 920.06 between pump and drive lantern.
4. For DK installation, fasten support foot 183 to drive lantern 341 with screwed connection 901.60 and to foot 182 with screwed connection 901.61.
5. Proceed with the installation as described in the corresponding sections.
(⇨ Section 5.3.2, Page 27) , (⇨ Section 5.3.4, Page 29)

7.6 Tightening torques

With the exception of the following screwed connections, all screws/bolts must be tightened as per the "Tightening torques" table.

Part No.	Description	[Nm]
900.01	Foundation bolts (M16)	48
900.01	Foundation bolts (M20)	96
901.54	Motor screws/bolts	Refer to the motor manufacturer's product literature.
901.14		
920.2	Gland follower nuts	As necessary for the required leakage (⇨ Section 6.1.4, Page 49)

Observe the following values:

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27 Applies to fixed bearings. For horizontal installation: non-drive end; for vertical installation: drive end

Table 19: Tightening torques [28)]

	Tightening torque M_A [Nm]															
Steel grade					**A2, A4**		**A2, A4**		**A2, A4**		**C3**		**1.4410**		**1.4462**	
Property class	**8.8**		**10.9**		**-50**		**-70**		**-80**		**-80**					
Thread	**Minimum**	**Nominal value**	**Minimum**	**Nominal value**	**Minimum**	**Nominal value**	**Minimum**	**Nominal value**	**Minimum**	**Nominal value**	**Minimum**	**Nominal value**	**Minimum**	**Nominal value**	**Minimum**	**Nominal value**
M4	3,0	3,0	4,5	5,0	1,0	1,1	2,1	2,4	2,9	3,2	3,0	3,4	2,5	2,8	2,1	2,4
M5	6,1	6,8	9,0	9,9	2,0	2,2	4,3	4,8	5,7	6,3	6,1	6,8	5,0	5,6	4,3	4,8
M6	10,3	11	15	17	3,4	3,7	7,2	8,0	9,6	11	10	11	8,5	9,5	7,2	8,0
M8	25	28	37	41	8,2	9,1	18	19	23	26	25	28	21	23	18	19
M10	49	55	72	80	16	18	35	38	46	51	49	55	41	45	35	38
M12	85	94	124	138	28	31	59	66	79	88	85	94	70	78	59	66
M14	134	149	197	219	44	49	94	105	126	140	134	149	111	124	94	105
M16	209	232	307	341	69	76	147	163	196	218	209	232	173	192	147	163
M20	408	453	599	666	134	149	287	319	382	425	408	453	338	375	287	319
M24	704	782	1034	1149	231	257	495	550	660	733	704	782	583	648	495	550
M27	1025	1139	1506	1673	336	374	721	801	961	1068	1025	1139	849	944	721	801
M30	1403	1559	2060	2289	460	511	986	1096	1315	1461	1403	1559	1162	1291	986	1096
M33	1888	2098	2773	3081	619	688	1327	1475	1770	1966	1888	2098	1563	1737	1327	1475
M36	2445	2717	3591	3990	802	891	1719	1910	2292	2547	2445	2717	2025	2250	1719	1910
M42	3904	4338	5734	6371	1281	1423	2745	3050	3660	4067	3904	4338	3233	3592	2745	3050
M48	5880	6534	8637	9596	1929	2144	4135	4594	5513	6125	5880	6534	4870	5411	4135	4594

NOTE

If using an adjustable torque wrench or torque screwdriver, adjust it to a value within the indicated range between the minimum and the nominal value.

7.7 Spare parts stock

7.7.1 Ordering spare parts

Always quote the following data when ordering replacement or spare parts:

- Order number
- Order item number
- Type series
- Size
- Material variant
- Year of construction

Refer to the name plate for all data.

Also specify the following data:

- Part No. and description (⇨ Section 9.2, Page 86)
- Quantity of spare parts
- Shipping address
- Mode of dispatch (freight, mail, express freight, air freight)

28 For μTotal = 0.14 and 90 % of the minimum yield strength

7.7.2 Recommended spare parts stock for 2 years' operation to DIN 24296

Table 20: Quantity of spare parts for recommended spare parts stock

Part No.	Description	Installation		Version		Number of pumps (including stand-by pumps)									
		Horizontal	Vertical	Gland packing	Mechanical seal	1	2	3	4	5	6	7	8	9	10 and more
Casing wear rings															
502	Casing wear ring	✗	✗	✗	✗	2	4	4	4	6	6	6	8	8	50 %
561.1	Grooved pin	✗	✗	✗	✗	4	8	8	8	12	12	12	16	16	50 %
Impeller wear ring															
503	Impeller wear ring	✗	✗	✗	✗	2	4	4	4	6	6	6	8	8	50 %
Fastening elements for the shaft															
920.1	Nut	-	✗	✗	✗	1	1	1	1	2	2	2	2	2	20 %
920.3	Nut	✗	-	✗	✗	1	1	1	1	2	2	2	2	2	20 %
932	Circlip	✗	✗	✗	✗	1	1	1	1	2	2	2	2	2	20 %
940.1	Key	✗	✗	✗	✗	1	1	1	1	2	2	2	2	2	20 %
940.2	Key	✗	✗	✗	✗	1	1	1	1	2	2	2	2	2	20 %
940.3	Key	✗	✗	✗	✗	1	1	1	1	2	2	2	2	2	20 %
950	Disc spring	✗	✗	✗	✗	1	1	1	1	2	2	2	2	2	20 %
Bearing assembly															
321	Deep groove ball bearing[29)]	✗	✗	✗	✗	2	2	2	2	4	4	6	8	8	50 %
350.2	Bearing housing	-	✗	✗	✗	1	1	1	1	2	2	3	4	4	50 %
520	Sleeve	✗	-	✗	✗	1	1	1	1	2	2	3	4	4	50 %
524.2	Shaft protecting sleeve	-	✗	✗	✗	1	1	1	1	2	2	3	4	4	50 %
545	Bearing bush	-	✗	✗	✗	1	1	1	1	2	2	3	4	4	50 %
550.1	Disc	✗	✗	✗	✗	2	2	2	2	4	4	6	8	8	50 %
550.2	Disc	✗	✗	✗	✗	3	3	3	3	6	6	9	12	12	50 %
Sealing elements															
411.1	V-ring[29)]	✗	✗	✗	✗	4	8	12	16	16	18	18	24	24	150 %
412.1	O-ring[29)]	✗	✗	✗	✗	4	8	12	16	16	18	18	24	24	150 %
412.2	O-ring	✗	✗	✗	✗	4	8	12	16	16	18	18	24	24	150 %
412.3	O-ring	✗	✗	✗	✗	4	8	12	16	16	18	18	24	24	150 %
412.4	O-ring	-	✗	✗	✗	2	4	6	8	8	9	9	12	12	150 %
412.5	O-ring	-	✗	✗	✗	2	4	6	8	8	9	9	12	12	150 %
412.6	O-ring	-	✗	✗	✗	2	4	6	8	8	9	9	12	12	150 %
421.1	Shaft seal	✗	✗	✗	✗	2	4	6	8	8	9	9	12	12	150 %
421.2	Shaft seal[29)]	✗	✗	✗	✗	4	8	12	16	16	18	18	24	24	150 %
Shaft protecting sleeve															
524.1	Shaft protecting sleeve[29)]	✗	✗	✗	✗	2	2	2	4	4	4	4	6	6	25 %
Mechanical seal															
433	Mechanical seal[29)]	✗	✗	-	✗	2	2	2	4	4	4	4	6	6	25 %
Mechanical seal installation kit															
457.2	Neck ring[29)]	✗	✗	-	✗	0	0	0	0	0	0	0	0	0	0 %
471	Seal cover[29)]	✗	✗	-	✗	0	0	0	0	0	0	0	0	0	0 %
525.2	Spacer sleeve[29)]	✗	✗	-	✗	0	0	0	0	0	0	0	0	0	0 %
Gland packing															

29 For vertical installation with product-lubricated plain bearing, halve the number of spare parts.

Part No.	Description	Installation		Version		Number of pumps (including stand-by pumps)									
		Horizontal	Vertical	Gland packing	Mechanical seal	1	2	3	4	5	6	7	8	9	10 and more
461	Packing rings[29)]	✘	✘	✘	-	6	12	24	24	36	36	36	48	48	0 %
Gland packing kit															
452	Gland follower[29)]	✘	✘	✘	-	2	4	4	8	8	8	12	12	16	30 %
455	Stuffing box insert[29)]	✘	✘	✘	-	2	4	4	8	8	8	12	12	16	30 %
457	Neck ring[29)]	✘	✘	✘	-	2	4	4	8	8	8	12	12	16	30 %
458	Lantern ring[29)]	✘	✘	✘	-	2	4	4	8	8	8	12	12	16	30 %

8 Trouble-shooting

⚠ WARNING

Improper work to remedy faults

Risk of injury!

- ▷ For any work performed to remedy faults, observe the relevant information given in this operating manual and/or in the product literature provided by the accessories manufacturer.

If problems occur that are not described in the following table, consultation with the KSB service is required.

A Pump discharge pressure too low
B Excessive discharge pressure
C Excessive flow rate
D Insufficient flow rate
E Excessive power consumption
F Pump is running, but does not deliver
G Pump stops during operation
H Vibrations and noise during pump operation
I Impermissible temperature increase in the pump
J Excessive bearing temperature
K Excessive leakage at the shaft seal
L Motor is overloaded
M Leakage at the pump

Table 21: Trouble-shooting

A	B	C	D	E	F	G	H	I	J	K	L	M	Possible causes	Remedy[30)]
✗	✗	✗	✗	✗	✗	-	✗	✗	-	-	✗	-	Operating point B does not match the Q and H performance data calculated in advance.	▪ Re-adjust to duty point.
-	-	-	-	-	✗	-	-	-	-	-	-	-	Pump and/or piping are not completely vented or primed.	▪ Vent.
✗	-	-	✗	-	✗	✗	✗	✗	-	-	-	-	Supply line or impeller clogged	▪ Clean the impeller. ▪ Check system for impurities. ▪ Remove deposits in pump and/or piping. ▪ Check any strainers installed/ suction opening.
-	-	-	-	-	✗	✗	✗	-	-	-	-	-	Formation of air pockets in the piping	▪ Correct suction conditions. ▪ Alter piping layout.
✗	-	-	✗	-	✗	✗	✗	-	-	-	-	-	Suction head too high (NPSH available too low) / water level too low	▪ Check operating mode. ▪ Correct suction conditions. ▪ Increase suction head. ▪ Increase back pressure by throttling. ▪ Install pump at a lower level. ▪ Alter suction/inlet line, if piping losses are too high.

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30 Pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.

A	B	C	D	E	F	G	H	I	J	K	L	M	Possible causes	Remedy[30)]
✗	-	-	✗	-	✗	✗	-	-	-	-	-	-	Air intake at the shaft seal	▪ Clean barrier fluid line, supply external barrier fluid, if necessary, or increase barrier fluid pressure. ▪ Check liquid supply system. ▪ Fit new shaft seal. ▪ Replace shaft protecting sleeve.
✗	-	-	✗	✗	-	-	✗	-	-	-	✗	-	Wrong direction of rotation	▪ Interchange two of the phases of the power cable. ▪ Check electrical connections. ▪ Check impeller position; correct if necessary.
✗	-	-	✗	-	-	-	✗	-	-	-	-	-	Speed is too low.	▪ Increase speed. ▪ Check switchgear. ▪ Fit larger impeller.
✗	-	-	✗	-	✗	✗	-	-	-	-	-	-	Wear of internal components	▪ Check duty point/pump selection. ▪ Increase back pressure by throttling. ▪ Check fluid handled for contamination by chemicals; check solids content. ▪ Replace worn components by new ones.
-	-	-	-	✗	-	-	-	-	-	-	✗	-	Pump pressure lower than specified in the purchase order	▪ Re-adjust to duty point. ▪ Increase back pressure by throttling.
-	-	-	-	✗	-	-	-	-	-	-	✗	-	Density or viscosity of fluid handled higher than stated in purchase order	▪ Reduce speed. ▪ In the case of persistent overloading, turn down impeller, if possible.
-	✗	✗	-	✗	-	-	✗	-	-	-	✗	-	Speed is too high.	▪ Reduce speed. ▪ In the case of persistent overloading, turn down impeller, if possible.
-	-	-	-	-	-	-	-	-	-	-	-	✗	Assembly bolts/sealing elements	▪ Check. ▪ Re-tighten the bolts. ▪ Fit new sealing elements. ▪ Check pipeline connections and secure fixing of pump; improve fixing of pipelines, if necessary.

A	B	C	D	E	F	G	H	I	J	K	L	M	Possible causes	Remedy[30)]
-	-	-	-	-	-	-	-	-	-	✗	-	-	Worn shaft seal	▪ Check flushing liquid/barrier fluid pressure. ▪ Clean barrier fluid line, supply external barrier fluid, if necessary, or increase barrier fluid pressure. ▪ Fit new shaft seal. ▪ Replace worn components by new ones. ▪ Replace shaft protecting sleeve.
✗	-	-	✗	-	-	-	✗	-	✗	-	-	-	Unfavourable flow to pump suction nozzle	▪ Alter piping layout. ▪ Alter suction/inlet line, if piping losses are too high. ▪ Check whether pipe routing results in swirling or irregular flow (e.g. downstream of elbow) and correct, if necessary.
-	-	-	-	-	-	-	-	✗	-	✗	-	-	Gland follower or seal cover tightened incorrectly; wrong packing material.	▪ Adjust. ▪ Replace. ▪ Correct. ▪ Replace gland packing. ▪ Replace worn components by new ones.
-	-	-	-	-	-	-	-	✗	-	✗	-	-	Lack of cooling liquid or dirty cooling chamber	▪ Check flushing liquid/barrier fluid pressure. ▪ Clean barrier fluid line, supply external barrier fluid, if necessary, or increase barrier fluid pressure. ▪ Increase cooling liquid quantity. ▪ Purify/clean cooling liquid.
-	-	-	-	-	-	-	✗	-	✗	-	-	-	Pump is warped or sympathetic vibrations in the piping.	▪ Re-align pump/drive. ▪ Check pipeline connections and secure fixing of pump; improve fixing of pipelines, if necessary. ▪ Fix pipelines using anti-vibration material.
-	-	-	-	-	-	-	-	-	✗	-	-	-	Increased axial thrust	▪ Check duty point/pump selection. ▪ Check operating mode. ▪ Check suction-side flow conditions.
-	-	-	-	-	-	-	-	-	✗	-	-	-	Insufficient or excessive quantity of lubricant or unsuitable lubricant	▪ Clean the bearings. ▪ Top up, reduce or change lubricant. ▪ Check oil lubrication system[31)]. ▪ Check oil supply[31)].

31 If any

A	B	C	D	E	F	G	H	I	J	K	L	M	Possible causes	Remedy[30)]
✗	-	-	✗	✗	-	-	-	-	-	-	✗	-	Motor is running on 2 phases only.	▪ Replace defective fuses. ▪ Check electrical connections. ▪ Check switchgear.
-	-	-	-	-	-	-	✗	-	✗	✗	-	-	Rotor out of balance	▪ Clean the rotor. ▪ Check run-out; re-align, if necessary. ▪ Re-balance the rotor.
-	-	-	-	-	-	-	✗	-	✗	✗	-	-	Defective bearing(s)	▪ Replace.
-	-	-	-	-	-	-	✗	✗	-	-	-	-	Flow rate is too low.	▪ Re-adjust to duty point. ▪ Fully open shut-off element in suction/inlet line. ▪ Fully open shut-off element in discharge line. ▪ Re-calculate or measure hydraulic losses H_V.
✗	-	-	✗	-	-	-	-	-	-	-	-	-	In star-delta operation, motor stuck at star stage	▪ Check electrical connections. ▪ Check switchgear.
✗	-	-	✗	-	-	-	✗	-	-	-	-	-	Impermissible air or gas content in fluid handled	▪ Vent. ▪ Check suction line for leakage, seal if necessary.
✗	-	-	✗	-	✗	✗	✗	-	-	-	-	-	Air intake at pump inlet	▪ Correct suction conditions. ▪ Reduce flow velocity at suction line inlet. ▪ Increase suction head. ▪ Check suction line for leakage, seal if necessary. ▪ Replace defective pipes.
-	-	-	-	-	-	-	✗	-	-	-	-	-	Cavitation (rattling noise)	▪ Correct suction conditions. ▪ Check operating mode. ▪ Increase suction head. ▪ Install pump at a lower level.
-	-	-	-	-	-	-	✗	-	✗	-	-	-	Foundation not rigid enough	▪ Check. ▪ Adjust.
✗	-	-	✗	-	✗	✗	✗	-	-	-	-	-	Impermissible parallel operation	▪ Re-adjust to duty point. ▪ Adjust pump characteristic H.
-	-	-	-	-	-	-	✗	-	-	✗	-	-	Shaft is out of true.	▪ Replace.
-	-	-	-	✗	-	-	✗	✗	✗	-	-	-	Impeller rubs against casing components.	▪ Check rotor. ▪ Check impeller position. ▪ Verify that piping has been connected without transmitting any stresses or strains.

8.1 Explanation of faults

The example illustrated in the diagram serves to facilitate understanding of the causes of faults/malfunctions and their remedies described in the Trouble-shooting section.

Many operating faults/malfunctions on pumps are caused by hydraulic phenomena. The hydraulic behaviour of a pump is illustrated by its characteristic curves H, P, Eta and NPSH in combination with the system characteristic curves H_A and $NPSH_A$ as a function of flow rate Q. The operating point B is given by the intersection between the system curve H_A and the pump's characteristic curve H.

If the cause of a fault or malfunction is unclear, consult your nearest KSB service centre.

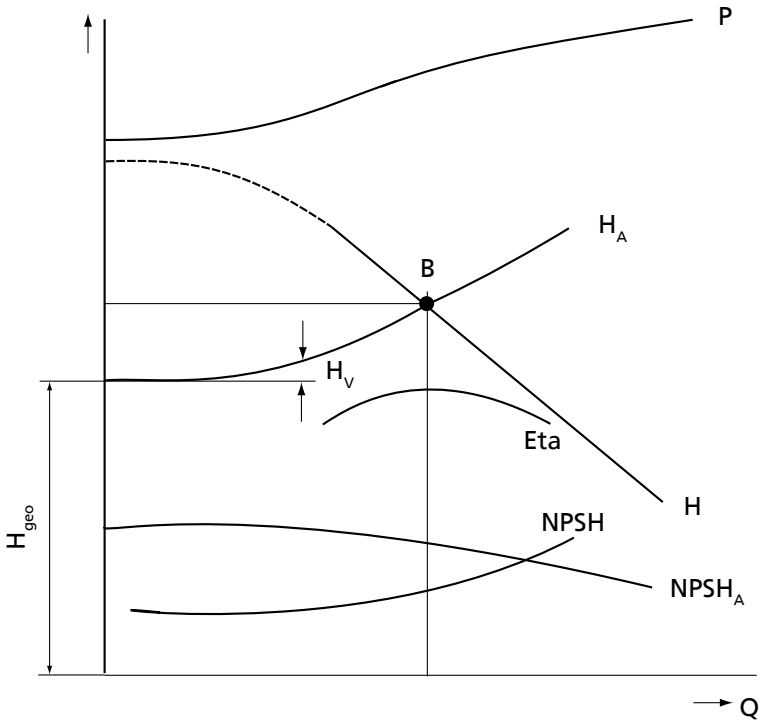

Fig. 38: Adjusting to the duty point

P	Pump power output	H_A	System curve
B	Operating point	H_v	Hydraulic losses (system)
H	Head	NPSH	Required inlet pressure
Eta	Efficiency	$NPSH_A$	Inlet pressure available in the system
Q	Flow rate	H_{geo}	Geodetic head

9 Related Documents

9.1 Weights of individual components

DANGER

Improper transport

Risk of injury from lifting heavy components!

- Select lifting accessories which are suitable for the component weight.
- Always use the attachment points provided for the lifting accessories.
- Observe the applicable accident prevention regulations.

Table 22: Weights of individual components

Size	Volute casing		Impeller	Shaft	Bearing housing	Shaft seal housing	Casing wear ring
	Lower section	Upper section					
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]
80-210	132	48	< 25	< 25	< 25	< 25	< 25
80-270	134	48	< 25	< 25	< 25	< 25	< 25
80-370	140	54	< 25	< 25	< 25	< 25	< 25
100-250	152	52	30	< 25	< 25	< 25	< 25
100-310	150	54	30	< 25	< 25	< 25	< 25
100-375	170	61	35	< 25	< 25	< 25	< 25
125-230	226	66	30	< 25	< 25	< 25	< 25
125-290	231	70	30	< 25	< 25	< 25	< 25
125-365	234	79	55	< 25	< 25	< 25	< 25
125-500	285	110	55	< 25	< 25	< 25	< 25
150-290	253	88	53	< 25	< 25	< 25	< 25
150-360	255	92	53	< 25	< 25	< 25	< 25
150-460	307	109	95	< 25	< 25	< 25	< 25
150-605	458	168	98	< 25	< 25	< 25	< 25
200-320	365	128	67	< 25	< 25	< 25	< 25
200-330	318	93	25,5	< 25	< 25	< 25	< 25
200-420	389	122	67	< 25	< 25	< 25	< 25
200-520	580	200	109	30	27	31	< 25
200-670	667	276	109	30	27	31	< 25
250-370	540	160	129	30	27	31	< 25
250-450	610	187	62	44	32	34	< 25
250-480	610	202	120	44	32	34	< 25
250-600	777	278	119	44	32	34	< 25
250-800	1097	509	239	63	35	43	< 25
300-300	558	189	87	30	27	31	< 25
300-435	725	250	126	44	32	34	< 25
300-560	1065	360	194	63	35	43	< 25
300-700	1295	444	194	63	35	43	< 25
300-860	2064	945	220	108	55	32	< 25
350-360	774	252	131	44	32	34	< 25
350-430	1050	344	136	63	35	43	< 25
350-510	889	378	172	63	35	43	< 25
400-500	1595	429	131	63	35	43	< 25

9.2 General assembly drawing with list of components

9.2.1 Horizontally installed pump

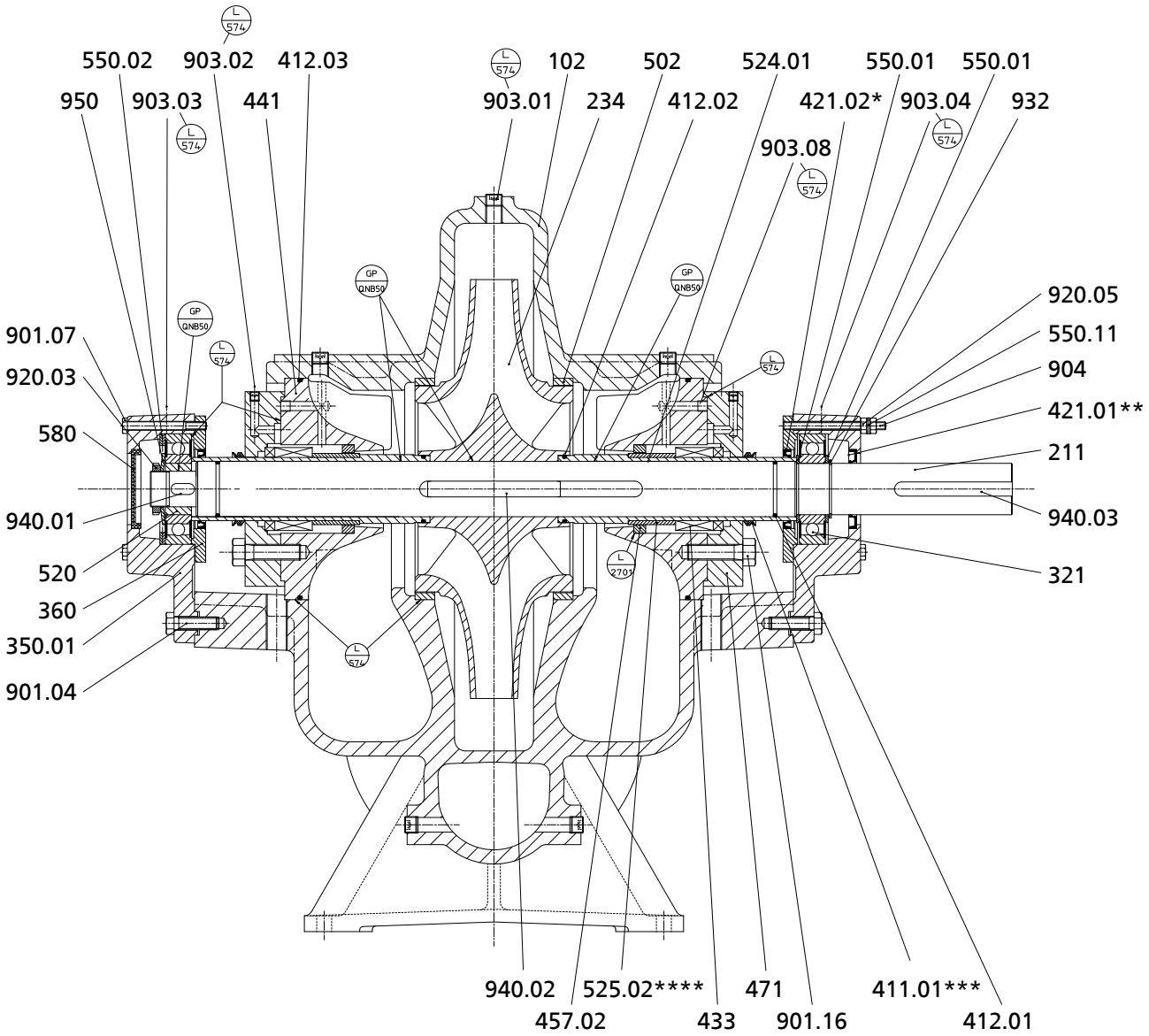

Fig. 39: General assembly drawing for horizontal installation
* For explosion-proof versions: labyrinth ring 423.02
** For explosion-proof versions: labyrinth ring 423.01
*** Not for explosion-proof versions
**** Not for versions with KSB mechanical seal 4OM

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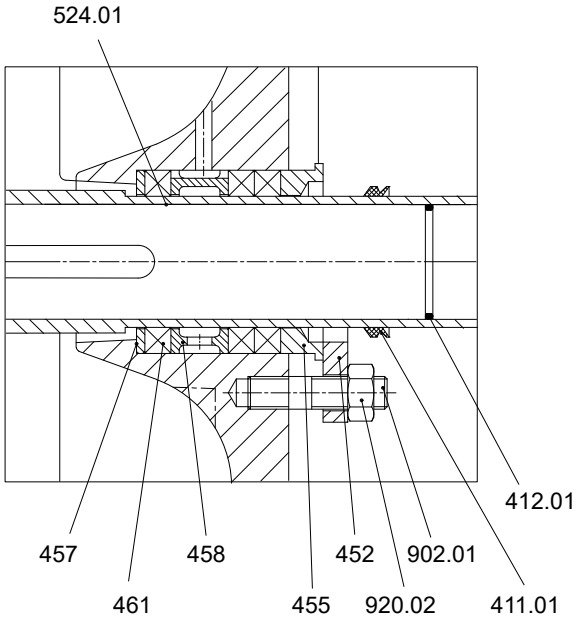
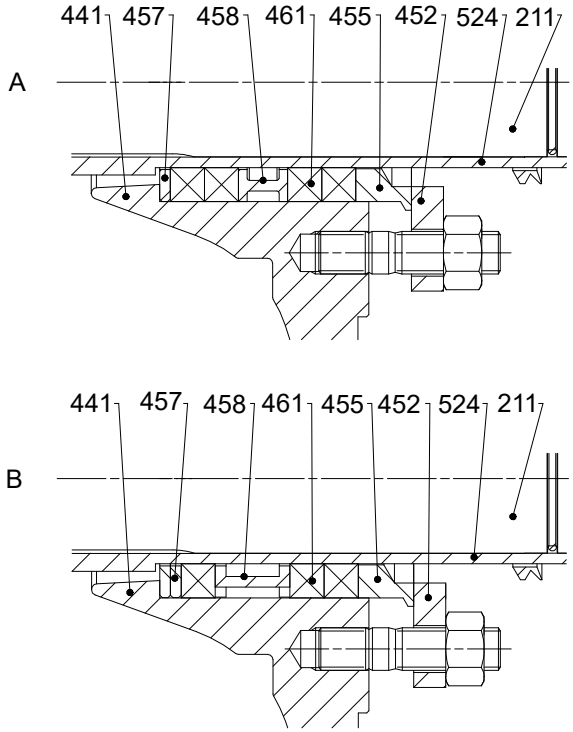
Detail drawing:
Gland packing, standard



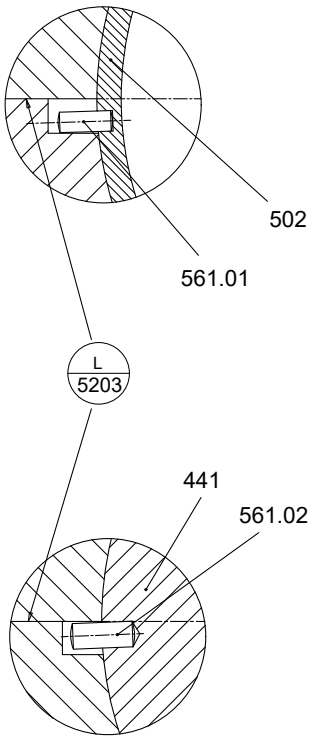
Detail drawing:
Gland packing for Omega FXF 200-330, FXF 200-520, FXF 200-670, FXF 250-450, FXF 250-600



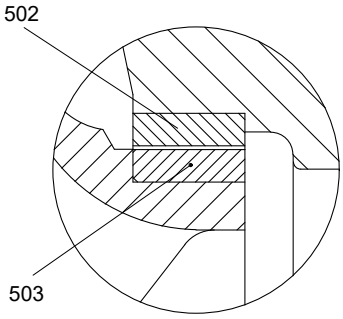
A = UL certification

B = FM certification

Detail drawing: pin position



Detail drawing: casing wear ring / impeller wear ring



Detail drawing: bolts at the casing split flange

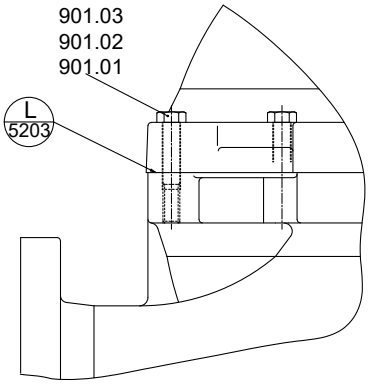


Table 23: List of components

Part No.	Description	Part No.	Description
102	Volute casing	502	Casing wear ring
211	Pump shaft	503	Impeller wear ring
234	Impeller	520	Sleeve
321	Radial ball bearing	524.01	Shaft protecting sleeve
350.01	Bearing housing	525.02	Spacer sleeve
360	Bearing cover	550.01/.02/.11	Disc
411.01	Joint ring	561.01/.02	Grooved pin
412.01/.02/.03	O-ring	580	Cap
421.01/.02	Lip seal	901.01/.02/.03/.04/.07/.16	Hexagon head bolt
433	Mechanical seal	902.01	Stud
441	Shaft seal housing	903.01/.02/.03/.04/.08	Screw plug
452	Gland follower	904	Grub screw
455	Stuffing box insert	920.02/.03/.05	Nut
457.02	Neck ring	932	Circlip
458	Lantern ring	940.01/.02/.03	Key
461	Gland packing	950	Spring
471	Seal cover		

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9.2.2 Vertically installed pump, installation type DJ

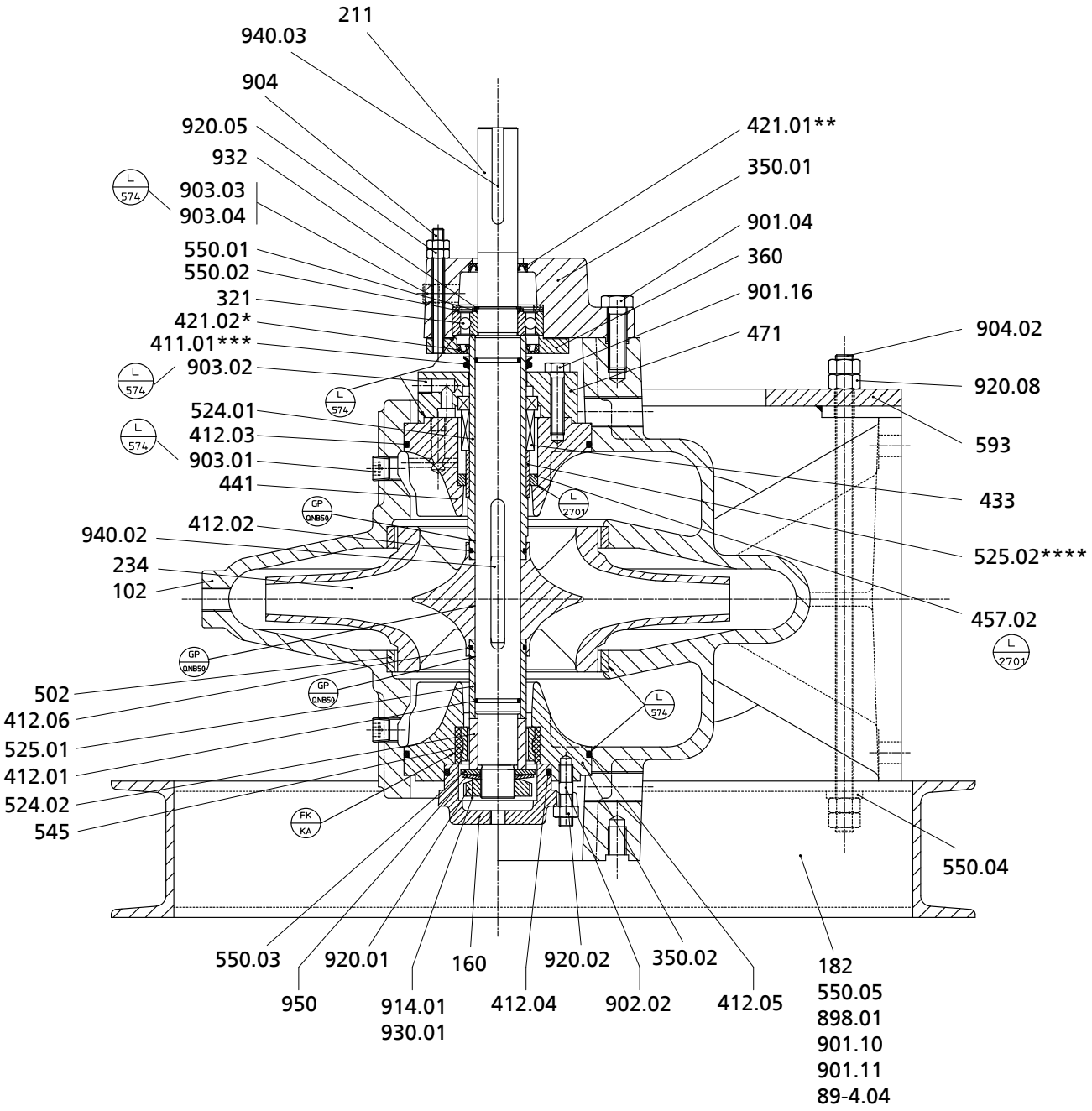
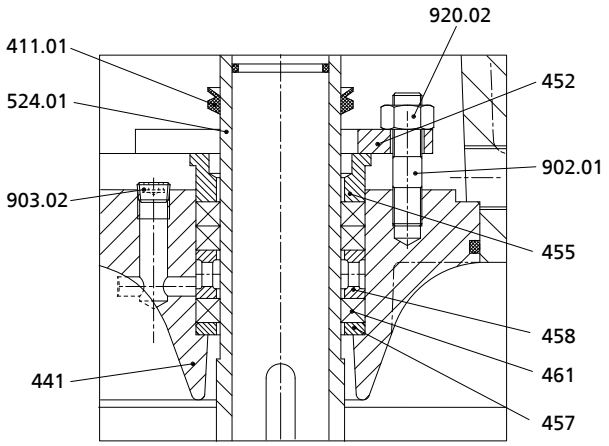
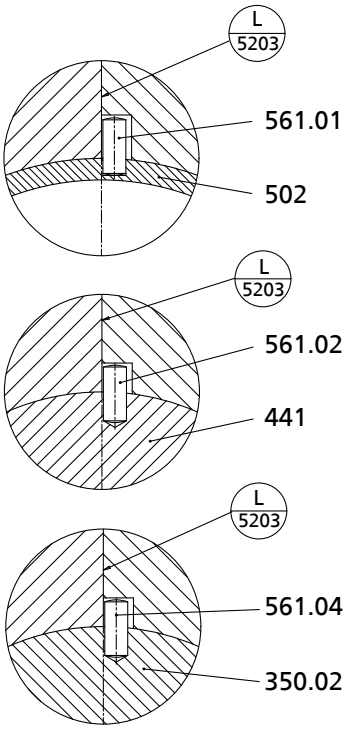


Fig. 40: General assembly drawing for installation type DJ
* For explosion-proof versions: labyrinth ring 423.02
** For explosion-proof versions: labyrinth ring 423.01
*** Not for explosion-proof versions
**** Not for versions with KSB mechanical seal 4OM

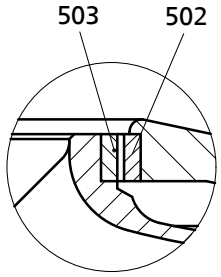
Detail drawing: gland packing



Detail drawing: pin position



Detail drawing: casing wear ring / impeller wear ring



Detail drawing: bolts at the casing split flange

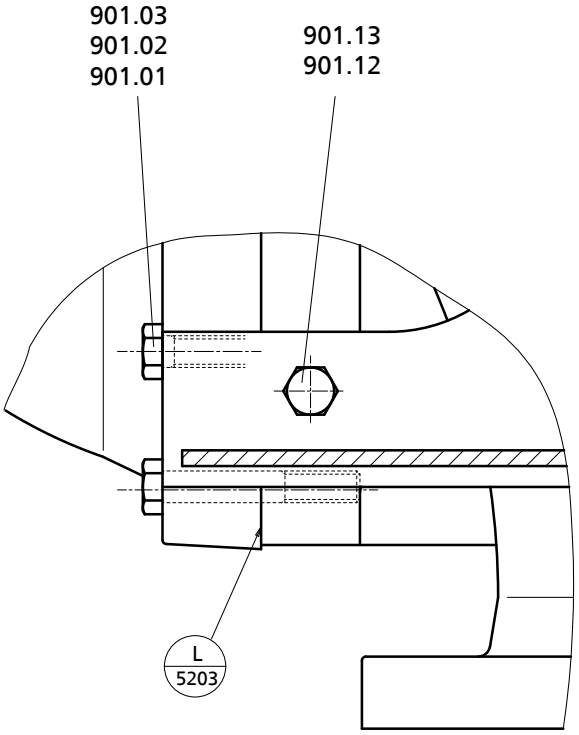


Table 24: List of components

Part No.	Description	Part No.	Description
102	Volute casing	503	Impeller wear ring
160	Cover	524.01/.02	Shaft protecting sleeve
182	Foot	525.01/.02	Spacer sleeve
211	Pump shaft	545	Bearing bush
234	Impeller	550.01/.02/.03/.04/.05	Disc

Part No.	Description	Part No.	Description
321	Radial ball bearing	561.01/.02/.04	Grooved pin
350.01/.02	Bearing housing	593	Rail
360	Bearing cover	89-4.04	Shim
411.01	Joint ring	898.01	Foundation block
412.01/.02/.03/.04/.05/.06	O-ring	901.01/.02/.03/.04/.10/.11/.12/.13/.16	Hexagon head bolt
421.01/.02	Lip seal	902.01/.02	Stud
433	Mechanical seal	903.01/.02/.03/.04	Screw plug
441	Shaft seal housing	904.02	Grub screw
452	Gland follower	914.01	Hexagon socket head cap screw
455	Stuffing box insert	920.01/.02/.05/.08	Nut
457.02	Neck ring	930.01	Safety device
458	Lantern ring	932	Circlip
461	Gland packing	940.02/.03	Key
471	Seal cover	950	Spring
502	Casing wear ring		

9.2.3 Vertically installed pump, installation type DB

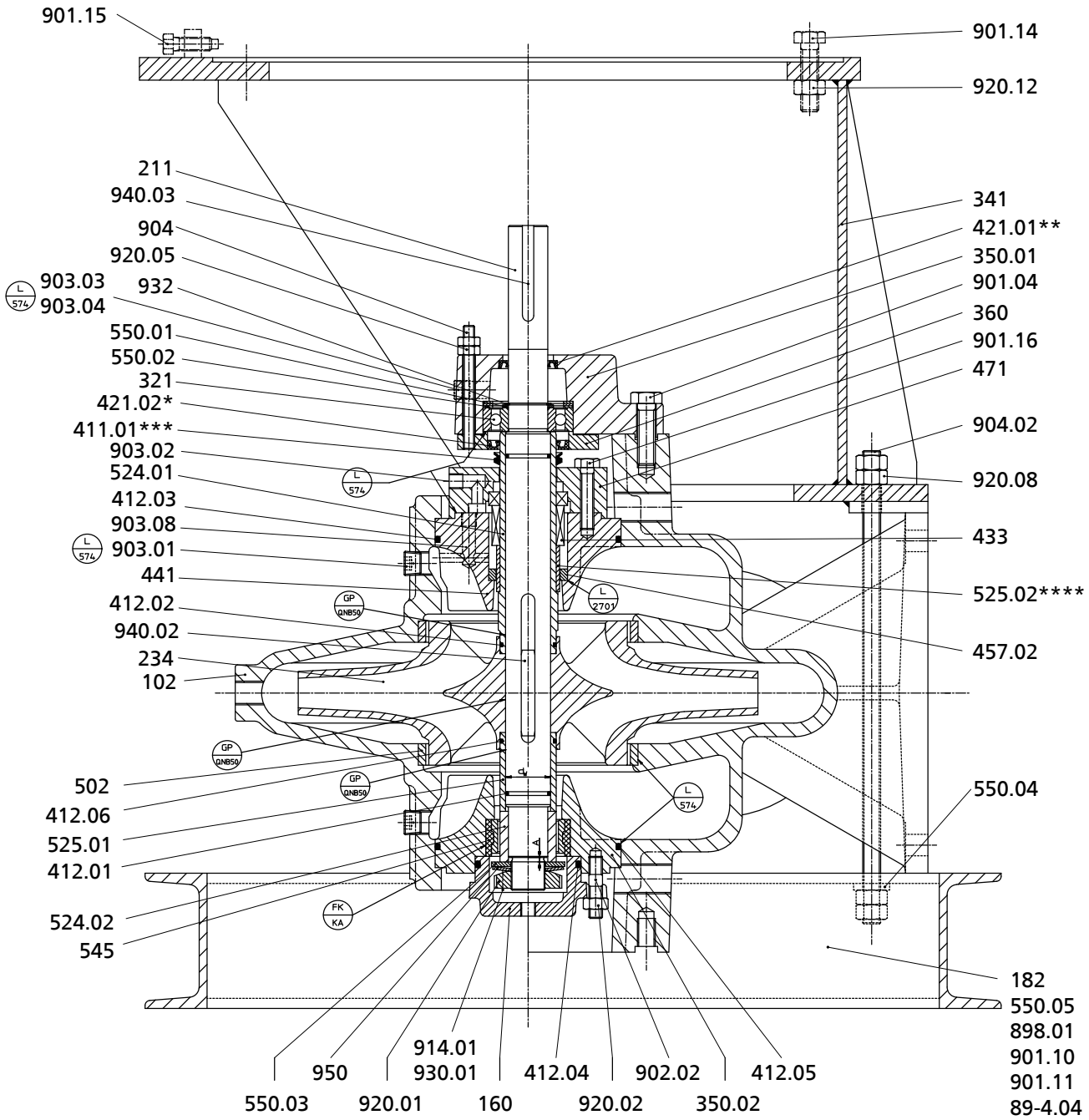


Fig. 41: General assembly drawing for installation type DB
* For explosion-proof versions: labyrinth ring 423.02
** For explosion-proof versions: labyrinth ring 423.01
*** Not for explosion-proof versions
**** Not for versions with KSB mechanical seal 4OM

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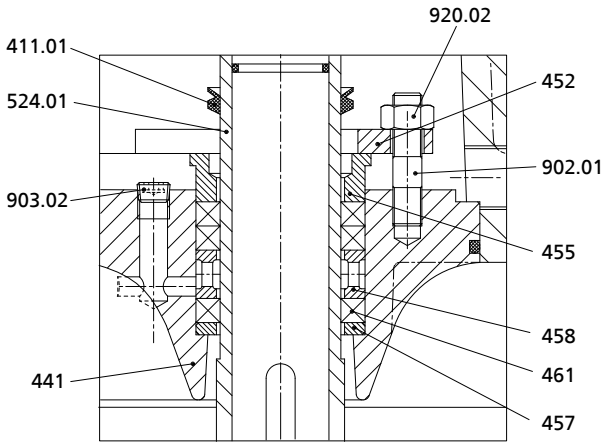
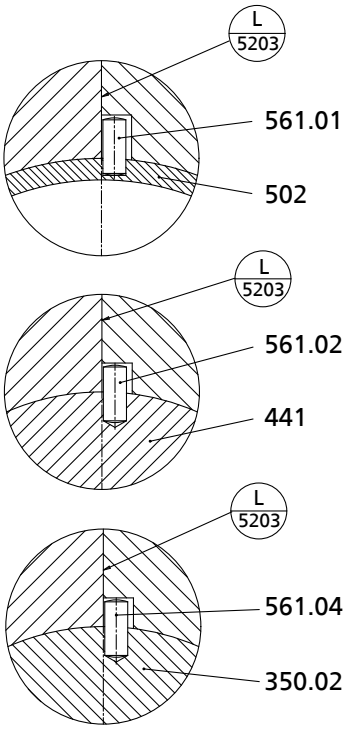
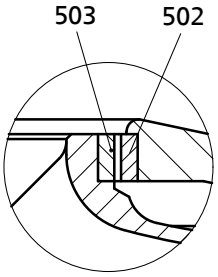
Detail drawing: gland packing



Detail drawing: pin position



Detail drawing: casing wear ring / impeller wear ring



Detail drawing: bolts at the casing split flange

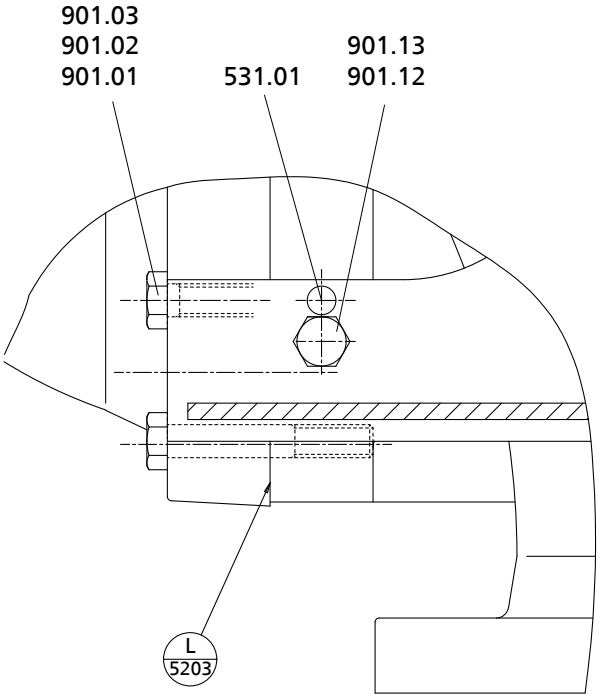


Table 25: List of components

Part No.	Description	Part No.	Description
102	Volute casing	502	Casing wear ring
160	Cover	503	Impeller wear ring
182	Foot	524.01/.02	Shaft protecting sleeve
211	Pump shaft	525.01/.02	Spacer sleeve
234	Impeller	531.01	Locking sleeve
321	Radial ball bearing	545	Bearing bush

Part No.	Description	Part No.	Description
341	Drive lantern	550.01/.02/.03/.04/.05	Disc
350.01/.02	Bearing housing	561.01/.02/.04	Grooved pin
360	Bearing cover	89-4.04	Shim
411.01	Joint ring	898.01	Foundation block
412.01/.02/.03/.04/.05/.06	O-ring	901.01/.02/.03/.04/.10/.11/.12/.13/.14/.15/.16	Hexagon head bolt
421.01/.02	Lip seal	902.01/.02	Stud
433	Mechanical seal	903.01/.02/.03/.04/.08	Screw plug
441	Shaft seal housing	904.02	Grub screw
452	Gland follower	914.01	Hexagon socket head cap screw
455	Stuffing box insert	920.01/.02/.05/.08/.12	Nut
457.02	Neck ring	930.01	Safety device
458	Lantern ring	932	Circlip
461	Gland packing	940.02/.03	Key
471	Seal cover	950	Spring

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9.2.4 Vertically installed pump, installation type DK

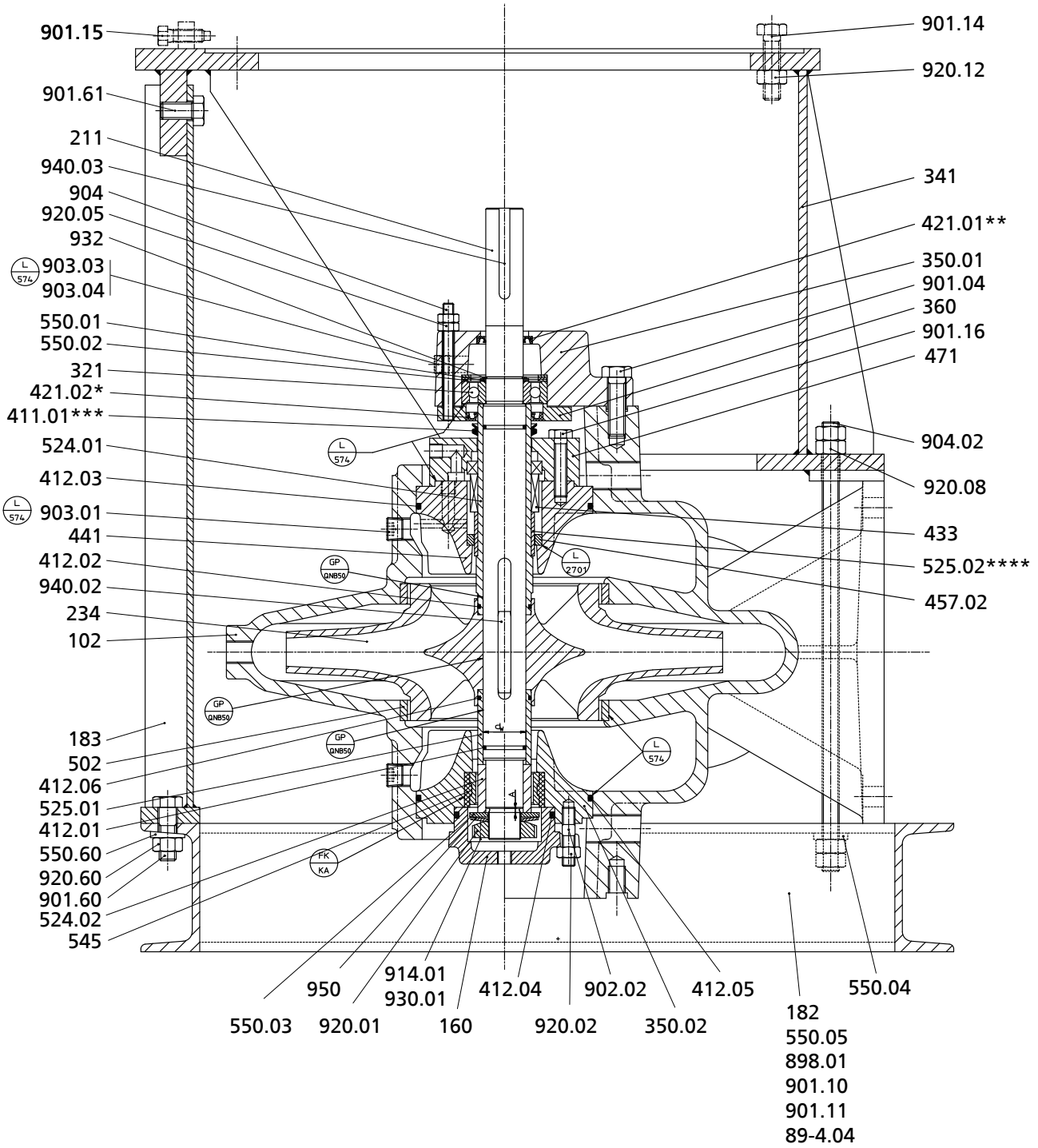
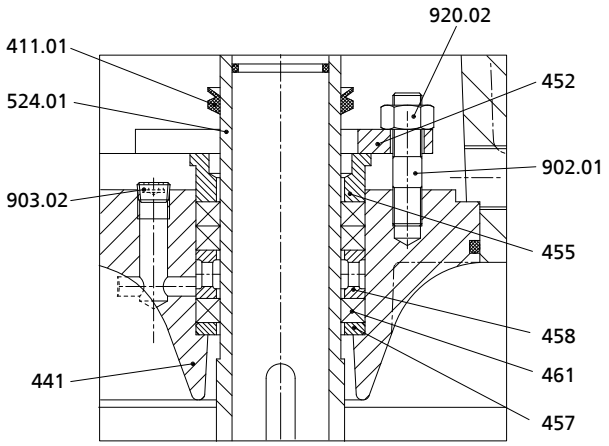
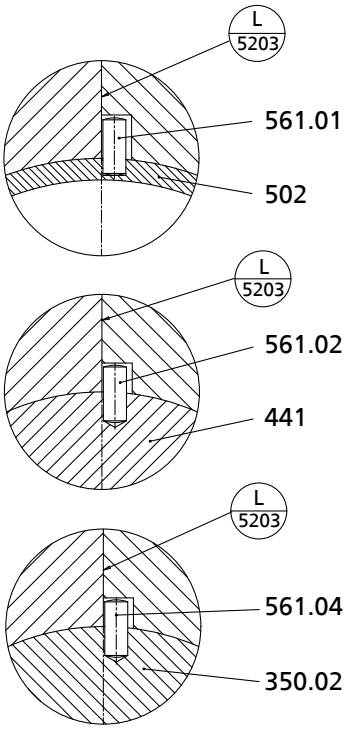


Fig. 42: General assembly drawing for installation type DK
* For explosion-proof versions: labyrinth ring 423.02
** For explosion-proof versions: labyrinth ring 423.01
*** Not for explosion-proof versions
**** Not for versions with KSB mechanical seal 4OM

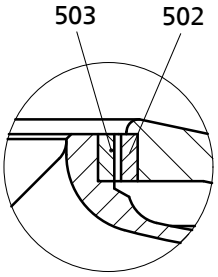
Detail drawing: gland packing



Detail drawing: pin position



Detail drawing: casing wear ring / impeller wear ring



Detail drawing: bolts at the casing split flange

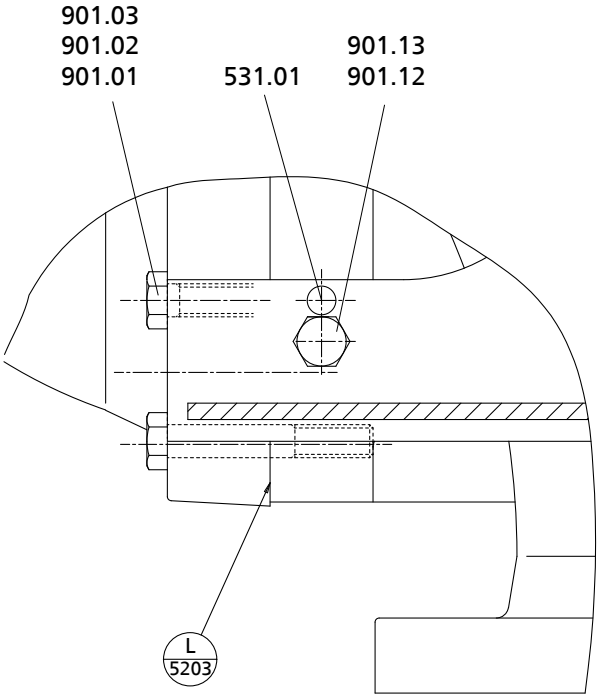


Table 26: List of components

Part No.	Description	Part No.	Description
102	Volute casing	502	Casing wear ring
160	Cover	503	Impeller wear ring
182	Foot	524.01/.02	Shaft protecting sleeve
183	Support foot	525.01/.02	Spacer sleeve
211	Pump shaft	531.01	Locking sleeve
234	Impeller	545	Bearing bush

Part No.	Description	Part No.	Description
321	Radial ball bearing	550.01/.02/.03/.04/.05/.60	Disc
341	Drive lantern	561.01/.02/.04	Grooved pin
350.01/.02	Bearing housing	89-4.04	Shim
360	Bearing cover	898.01	Foundation block
411.01	Joint ring	901.01/.02/.03/.04/.10/.11/.12/.13/.14/.15/.16/.60/.61	Hexagon head bolt
412.01/.02/.03/.04/.05/.06	O-ring	902.01/.02	Stud
421.01/.02	Lip seal	903.01/.02/.03/.04	Screw plug
433	Mechanical seal	904.02	Grub screw
441	Shaft seal housing	914.01	Hexagon socket head cap screw
452	Gland follower	920.01/.02/.05/.08/.12	Nut
455	Stuffing box insert	930.01	Safety device
457.02	Neck ring	932	Circlip
458	Lantern ring	940.02/.03	Key
461	Gland packing	950	Spring
471	Seal cover		

9.2.5 Vertically installed pump, installation type DP

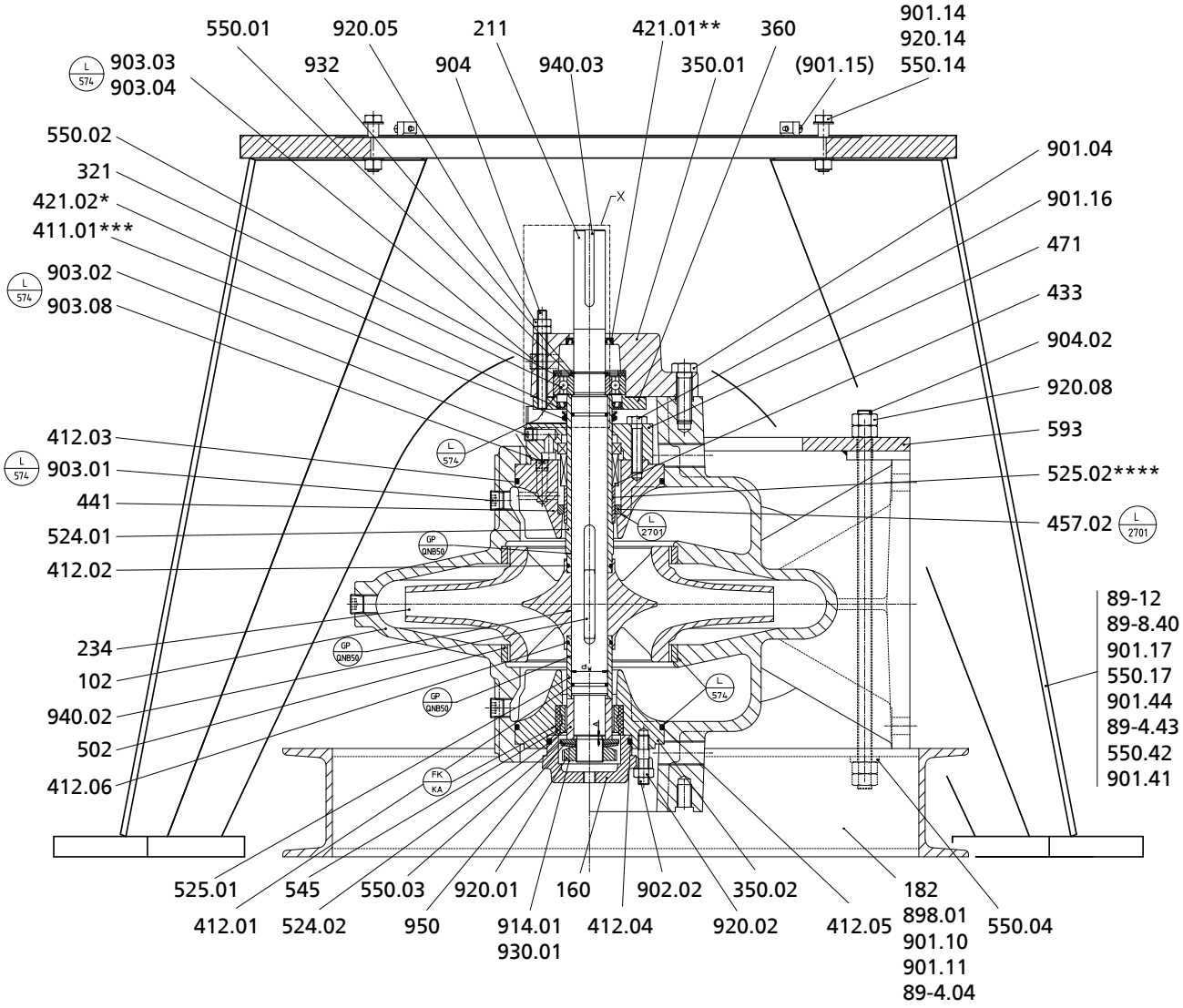


Fig. 43: General assembly drawing for installation type DP
* For explosion-proof versions: labyrinth ring 423.02
** For explosion-proof versions: labyrinth ring 423.01
*** Not for explosion-proof versions
**** Not for versions with KSB mechanical seal 4OM

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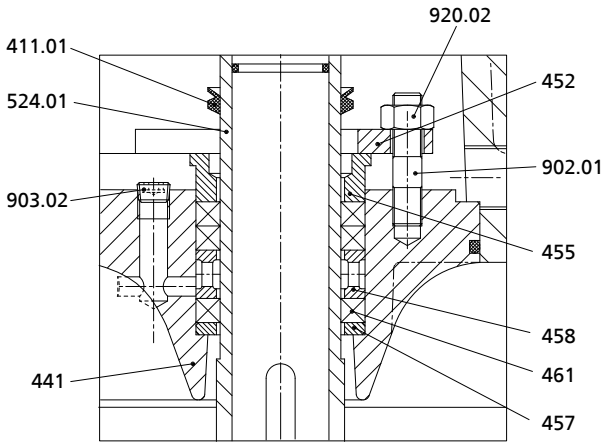
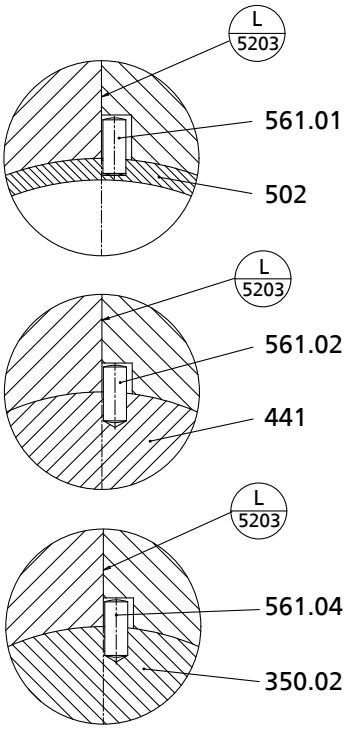
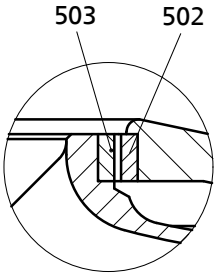
Detail drawing: gland packing



Detail drawing: pin position



Detail drawing: casing wear ring / impeller wear ring



Detail drawing: bolts at the casing split flange

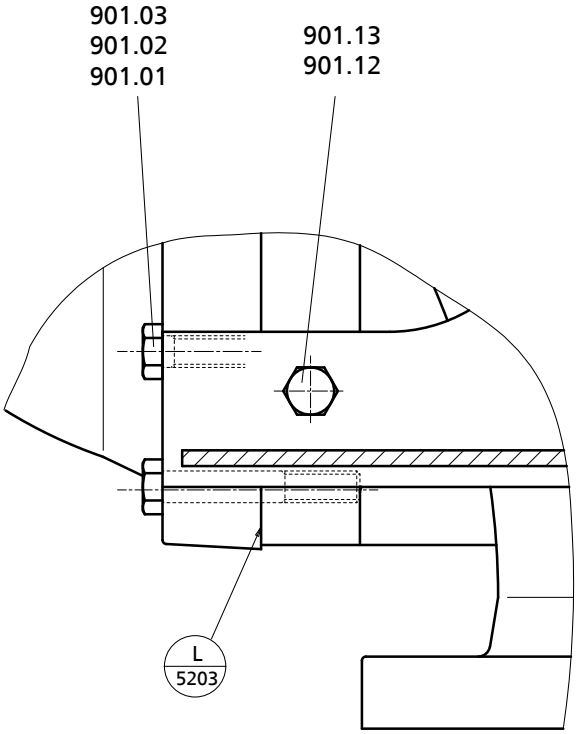


Table 27: List of components

Part No.	Description	Part No.	Description
102	Volute casing	503	Impeller wear ring
160	Cover	524.01/.02	Shaft protecting sleeve
182	Foot	525.01/.02	Spacer sleeve
211	Pump shaft	545	Bearing bush
234	Impeller	550.01/.02/.03/.04/.05/.17	Disc

Part No.	Description	Part No.	Description
321	Radial ball bearing	561.01/.02/.04	Grooved pin
350.01/.02	Bearing housing	593	Rail
360	Bearing cover	89-4.04	Shim
411.01	Joint ring	898.01	Foundation block
412.01/.02/.03/.04/.05/.06	O-ring	901.01/.02/.03/.04/.10/.11/.12/.16/.17	Hexagon head bolt
421.01/.02	Lip seal	902.01/.02	Stud
433	Mechanical seal	903.01/.02/.03/.04	Screw plug
441	Shaft seal housing	904.02	Grub screw
452	Gland follower	914.01	Hexagon socket head cap screw
455	Stuffing box insert	920.01/.02/.05/.08	Nut
457.02	Neck ring	930.01	Safety device
458	Lantern ring	932	Circlip
461	Gland packing	940.02/.03	Key
471	Seal cover	950	Spring
502	Casing wear ring		

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10 EU Declaration of conformity

Manufacturer: **KSB SE & Co. KGaA**
Johann-Klein-Straße 9
67227 Frankenthal (Germany)

The manufacturer herewith declares that **the product**:

Omega, Omega V

KSB order number: .....

- is in conformity with the provisions of the following directives / regulations as amended from time to time:
  - Pump (set): 2006/42/EC Machinery Directive

The manufacturer also declares that

- the following harmonised international standards[32)] have been applied:
  - ISO 12100
  - EN 809

Person authorised to compile the technical file:

Name
Function
Address (company)
Address (street, No.)
Address (post or ZIP code, city) (country)

The EU Declaration of Conformity was issued in/on:

Place, date

.....[33)].....

Name

Function

Company
Address

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32 Apart from the standards listed here referring to the Machinery Directive, further standards are observed for explosion-proof versions (ATEX Directive) as applicable and are listed in the legally binding EU Declaration of Conformity.

33 A signed, legally binding EU Declaration of Conformity is supplied with the product.

11 Certificate of Decontamination

Type: .....

Order number /

Order item number[34]: .....

Delivery date: .....

Application: .....

Fluid handled[34]: .....

Please tick where applicable[34]:

☐ Corrosive

☐ Oxidising

☐ Flammable

☐ Explosive

☐ Hazardous to health

☐ Seriously hazardous to health

☐ Toxic

☐ Radioactive

☐ Bio-hazardous

☐ Safe

Reason for return:[34]: .....

Comments: .....

.....

The product / accessories have been carefully drained, cleaned and decontaminated inside and outside prior to dispatch / placing at your disposal.

We herewith declare that this product is free from hazardous chemicals and biological and radioactive substances.

For mag-drive pumps, the inner rotor unit (impeller, casing cover, bearing ring carrier, plain bearing, inner rotor) has been removed from the pump and cleaned. In cases of containment shroud leakage, the outer rotor, bearing bracket lantern, leakage barrier and bearing bracket or intermediate piece have also been cleaned.

For canned motor pumps, the rotor and plain bearing have been removed from the pump for cleaning. In cases of leakage at the stator can, the stator space has been examined for fluid leakage; if fluid handled has penetrated the stator space, it has been removed.

☐ No special safety precautions are required for further handling.

☐ The following safety precautions are required for flushing fluids, fluid residues and disposal:

.....

.....

We confirm that the above data and information are correct and complete and that dispatch is effected in accordance with the relevant legal provisions.

.....	.....	.....
Place, date and signature	Address	Company stamp

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34 Required field

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