

Process Pump

RPH-V

Installation/Operating Manual



Legal information/Copyright

Installation/Operating Manual RPH-V

Original operating manual

All rights reserved. The contents provided herein must neither be distributed, copied, reproduced, edited or processed for any other purpose, nor otherwise transmitted, published or made available to a third party without the manufacturer's express written consent.

Subject to technical modification without prior notice.

© KSB Brasil Ltda., Várzea Paulista 23/07/2020

Contents

	Glossary	5
1	General.....	6
1.1	Principles	6
1.2	Installation of partly completed machinery.....	6
1.3	Target group.....	6
1.4	Other applicable documents.....	6
1.5	Symbols	6
2	Safety	8
2.1	Key to safety symbols/markings.....	8
2.2	General.....	8
2.3	Intended use	9
2.4	Personnel qualification and training.....	9
2.5	Consequences and risks caused by non-compliance with this manual	9
2.6	Safety awareness	9
2.7	Safety information for the operator/user	9
2.8	Safety information for maintenance, inspection and installation	10
2.9	Unauthorised modes of operation	10
2.10	Explosion protection	10
3	Transport/Storage/Disposal	13
3.1	Checking the condition upon delivery	13
3.2	Transport.....	13
3.3	Storage/preservation	14
3.4	Return to supplier.....	14
3.5	Disposal	15
4	Description of the Pump (Set)	16
4.1	General description	16
4.2	Designation.....	16
4.3	Name plate.....	16
4.4	Design details.....	16
4.5	Configuration and function.....	18
4.6	Noise characteristics	19
4.7	Scope of supply.....	19
4.8	Dimensions and weights	20
5	Installation at Site	21
5.1	Safety regulations.....	21
5.2	Checks to be carried out prior to installation.....	21
5.3	Installing the pump set	21
5.4	Piping	24
5.5	Enclosure/insulation	26
5.6	Checking the coupling alignment	27
5.7	Aligning the pump and motor	28
5.8	Electrical connection	28
5.9	Checking the direction of rotation.....	29
6	Commissioning/Start-up/Shutdown	30
6.1	Commissioning/Start-up.....	30
6.2	Operating limits.....	35
6.3	Shutdown/storage/preservation	37
6.4	Returning to service	38
7	Servicing/Maintenance	39
7.1	Safety regulations.....	39

7.2	Servicing/Inspection.....	40
7.3	Drainage/cleaning	45
7.4	Dismantling the pump set.....	45
7.5	Reassembling the pump set.....	47
7.6	Tightening torques.....	50
7.7	Spare parts stock.....	50
8	Trouble-shooting.....	53
9	Related Documents	55
9.1	General assembly drawings with list of components.....	55
10	EU Declaration of Conformity	59
11	Certificate of Decontamination.....	60
	Index	61

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

Hydraulic system

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

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

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 2.4, Page 9)

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)
Installation plan/dimensional drawing	Description of mating 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 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
Drawing for assembly ¹⁾	Sectional drawing of the installed shaft seal


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

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 If agreed upon in scope of supply

Symbol	Description
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product










2 Safety

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 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.

2.2 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.

2.3 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 model.
- 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.

2.4 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.

2.5 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

2.6 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

2.7 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 shutting down 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.

2.8 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.
- When taking the pump set out of service always adhere to the procedure described in the manual. (⇒ Section 6.3, Page 37)
- Decontaminate pumps which handle fluids posing a health hazard.
- 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 30)

2.9 Unauthorised modes of operation

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

The warranty relating to the operating reliability and safety of the supplied pump (set) is only valid if the equipment is used in accordance with its intended use. (⇒ Section 2.3, Page 9)

2.10 Explosion protection

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

Only pumps/pump sets marked as explosion-proof **and** identified as such in the data sheet may be used in potentially explosive atmospheres.

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

Especially adhere to the sections in this manual marked with the symbol opposite and the following sections, (⇒ Section 2.10.1, Page 10) to (⇒ Section 2.10.4, Page 11) The explosion-proof status of the pump set is only assured if the pump set is used in accordance with its intended use.

Never operate the pump set outside the limits stated in the data sheet and on the name plate.

Prevent impermissible modes of operation at all times.

2.10.1 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 individual Temperature Limits table for the temperatures permitted for the individual pump variants.

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.

2.10.2 Temperature limits

In normal pump operation, the highest temperatures on accessible components are to be expected on the surface of the soleplate and the discharge piping, at the shaft seal and in the bearing areas.

The surface temperature at the discharge piping 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 below lists the temperature classes and the resulting theoretical temperature limits of the fluid handled (a possible temperature rise in the shaft seal area has already been taken into account).

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	Maximum permissible fluid temperature
T1	Maximum 400 °C ²⁾
T2	280 °C
T3	185 °C
T4	120 °C

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, if there is no data sheet or if the pump is part of a pool of pumps, contact KSB for the maximum permissible operating temperature.

2.10.3 Monitoring equipment

The pump (set) must only be operated within the limits specified in the data sheet and on the name plate.

If the system operator cannot warrant compliance with these operating limits, appropriate monitoring devices must be used.

Check whether monitoring equipment is required to ensure that the pump set functions properly.

Contact KSB for further information about monitoring equipment.

2.10.4 Operating limits

The minimum flow rates indicated in (⇒ Section 6.2.3.1, Page 36) refer to water and water-like fluids handled. Longer operating periods with these fluids and at the flow rates indicated will not cause an additional increase in the temperatures at the pump surface. However, if the physical properties of the fluids handled are different from water, it is essential to check whether an additional heat build-up may occur

² Depending on the material variant



and if the minimum flow rate must therefore be increased. The calculation formula in (⇒ Section 6.2.3.1, Page 36) can be used to check whether additional heat build-up may lead to a dangerous temperature increase at the pump surface.

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

	<div style="background-color: #e67e22; color: white; padding: 5px;">! DANGER</div> <p>The pump (set) could slip out of the suspension arrangement Danger to life from falling parts!</p> <ul style="list-style-type: none"> ▷ 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.
	<div style="background-color: #f1c40f; color: black; padding: 5px;">CAUTION</div> <p>Incorrect transport of the pump Damage to the shaft seal!</p> <ul style="list-style-type: none"> ▷ For transport, lock the pump shaft with a suitable transport lock to prevent any movement of the shaft.

To transport the pump/pump set or back pull-out unit suspend it from the lifting tackle as shown.

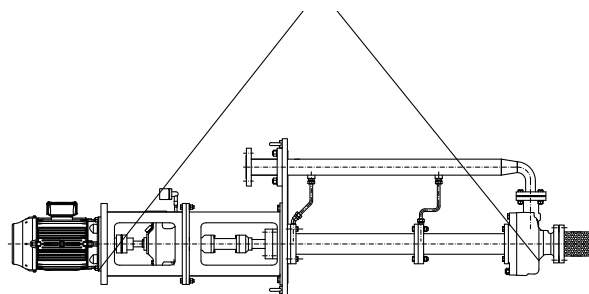


Fig. 1: Transporting the assembled unit

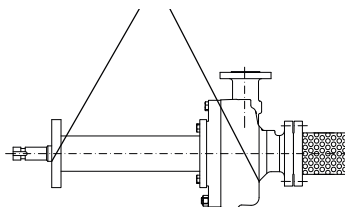




Fig. 2: Transporting the pump casing and part of the support column

3.3 Storage/preservation

	<p>CAUTION</p> <p>Damage during storage due to humidity, dirt or vermin Corrosion/contamination of the pump (set)!</p> <ul style="list-style-type: none"> ▸ For outdoor storage cover the pump (set) or the packaged pump (set) and accessories with waterproof material.
	<p>CAUTION</p> <p>Wet, contaminated or damaged openings and connections Leakage or damage to the pump!</p> <ul style="list-style-type: none"> ▸ Clean and cover pump openings and connections as required prior to putting the pump into storage.

If commissioning is to take place some time after delivery, we recommend that the following measures be taken for pump (set) storage.

- Store the pump (set) in a dry, protected room where the atmospheric humidity is as constant as possible.
- Rotate the shaft by hand once a month, e.g. via the motor fan.

If properly stored indoors, the equipment is protected for a maximum of 6 months. New pumps/pump sets are supplied by our factory duly prepared for storage.



For storing a pump (set) which has already been operated, observe the instructions in (⇒ Section 6.3.1, Page 37) .

3.4 Return to supplier

1. Drain the pump as per operating instructions.
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 also neutralise the pump and blow through with anhydrous inert gas 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 60)

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

3.5 Disposal

	 WARNING
	<p>Fluids handled, consumables and supplies which are hot and/or pose a health hazard</p> <p>Hazard to persons and the environment!</p> <ul style="list-style-type: none">▸ 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.

4 Description of the Pump (Set)

4.1 General description

- Process pump to API 610

Pump for handling the large variety of petroleum products in refineries as well as in the chemical and petrochemical industry.

4.2 Designation

Example: RPH-V 50-180

Table 5: Designation key

Code	Description
RPH	Type series
V	Vertical installation
50	Nominal discharge nozzle diameter [mm] of volute casing
180	Nominal impeller diameter [mm]

4.3 Name plate

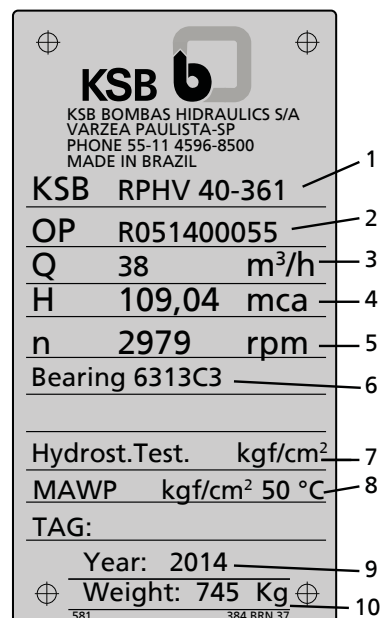


Fig. 3: Name plate (example)

1	Type series, size	2	Order number
3	Flow rate	4	Head
5	Speed	6	Bearing design
7	Test pressure	8	Max. permissible operating pressure
9	Year of construction	10	Weight

4.4 Design details

Design

- Volute casing pump
- Vertical installation
- Single-stage

- Meets the technical requirements to API 610, 11th edition / ISO 13709
- Shaft deflection to API 610, 11th edition
- Pump shaft, intermediate shaft and top shaft are connected by a conical coupling.

Direction of rotation

- Clockwise, viewed from the drive end.

Drive

- Electric motor
- Internal combustion engine
- Turbine

Shaft seal

Standard design:

- Mechanical seal
- Mechanical seal chamber to API 610, 11th edition

Pump casing

- Radially split volute casing
- Volute casing with casing wear ring
- Casing cover

Impeller type

- Closed radial impeller
- Impeller with impeller wear ring on the suction side only for hydraulically balanced impellers

Balancing device

- Sealing clearance and balancing holes balance axial thrust (if required).

Soleplate seal

- Discharge line sealed at the soleplate with O-rings

Bearings

- Oil-lubricated radial ball bearing
- Sealing with labyrinth ring

Optional:

- Grease-packed radial ball bearing

Shaft guide bearings:

- Radial plain bearings made of GTC-AR-HT (or 3P/Xytrex 451)
- With shaft protecting sleeve

Optional:

- Lubricated with water from an external source³⁾

³⁾ Water is supplied to all shaft guide bearings through an external connection located above the soleplate.

4.5 Configuration and function

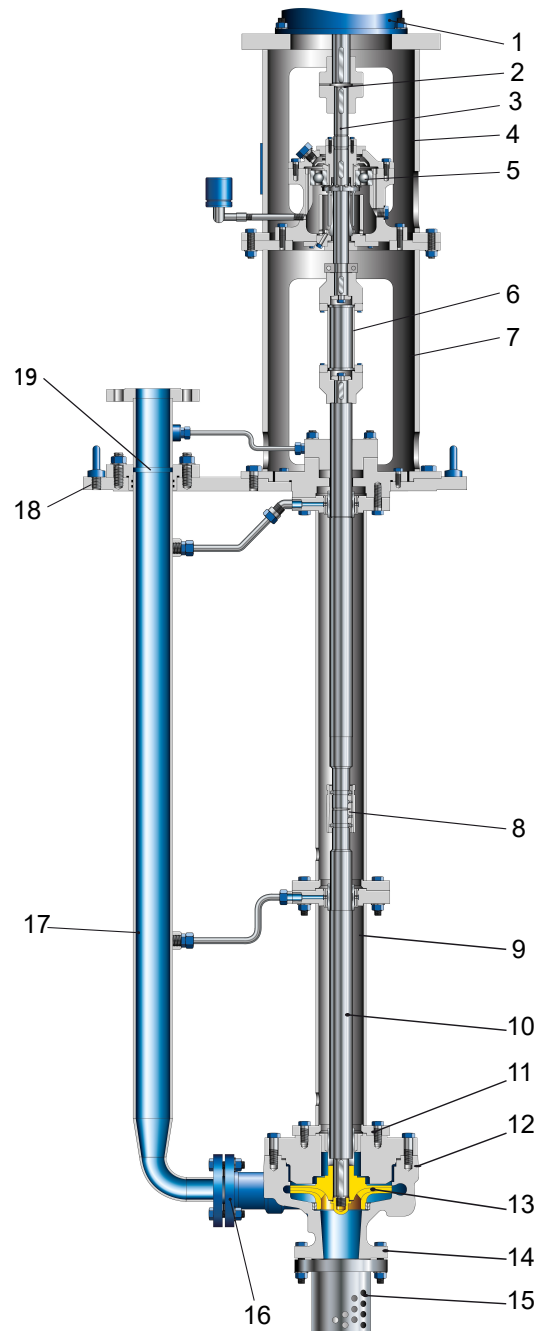


Fig. 4: Sectional drawing

1	Motor housing	2	Coupling
3	Top shaft	4	Drive lantern
5	Radial ball bearing	6	Intermediate coupling
7	Bearing bracket lantern	8	Conical coupling
9	Support column	10	Pump shaft
11	Casing cover	12	Volute casing
13	Impeller	14	Suction nozzle
15	Suction strainer	16	Discharge nozzle, volute casing
17	Riser	18	Soleplate
19	Discharge nozzle, soleplate		

Design The pump is designed with an axial fluid inlet and a radial outlet. The hydraulic system is rigidly connected to the motor via a multiple-disc coupling. It runs in product-lubricated plain bearings in the support column, which compensate any

lateral movement or shaft deflection. The graded lengths of the support column (9) and shaft allow the pump set to be matched to various immersion depths. The pump set is mounted on a soleplate (18). A riser (17) connects the discharge nozzle (16) of the volute casing with the discharge nozzle (19) of the soleplate (18).

Function The fluid enters the pump via the suction nozzle (14) and is accelerated outward by the rotating impeller (13). 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 (16), where it leaves the pump. At the rear side of the impeller, the shaft enters the hydraulic system through the casing cover. The shaft runs in plain bearings, which are supported by column pipe with integrated spider bearings connected to the pump casing and/or casing cover.

Sealing The pump is sealed by a standardised mechanical seal.

4.6 Noise characteristics

Table 6: Surface sound pressure level $L_{pA}^{4)5)}$

P_N	Pump			Pump set		
	960 rpm, 760 rpm	1450 rpm	2900 rpm	960 rpm, 760 rpm	1450 rpm	2900 rpm
[kW]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
1,5	52	53	54	56	58	63
2,2	53	55	56	58	60	66
3	55	56	57	60	62	68
4	56	58	59	61	63	69
5,5	58	59	61	62	65	71
7,5	59	61	62	64	66	72
11	61	63	64	65	68	74
15	63	65	66	67	69	75
18,5	64	66	67	68	70	76
22	65	67	68	68	71	77
30	66	68	70	70	72	78
37	67	70	71	70	73	79
45	68	71	72	71	74	80
55	69	72	73	72	74	80
75	71	73	75	73	76	81
90	71	74	76	73	76	82
110	72	75	77	74	77	82
132	73	76	78	75	77	83
160	74	77	79	75	78	84
200	75	78	80	76	79	84
250	-	79	81	-	80	85

4.7 Scope of supply

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

⁴ Surface sound pressure level as per ISO 3744 and EN 12639; valid for pump operation in the $Q/Q_{BEP} = 0.8 - 1.1$ range and for non-cavitating operation. If noise levels are to be guaranteed: add +3 dB for measuring and constructional tolerance.

⁵ Increase for 60 Hz operation: 3500 rpm +3 dB, 1750 rpm +1 dB, 1160 rpm ± 0 dB

Coupling

Contact guard

Soleplate

- Rectangular or circular
- With riser

Accessories



- As required

4.8 Dimensions and weights

For dimensions and weights please refer to the general arrangement drawing/outline drawing of the pump/pump set.



5 Installation at Site

5.1 Safety regulations

	 DANGER
	<p>Excessive temperatures in the shaft seal area Explosion hazard!</p> <ul style="list-style-type: none"> ▷ Never operate a pump (set) with gland packing in potentially explosive atmospheres.

5.2 Checks to be carried out prior to installation



Place of installation

	 WARNING
	<p>Installation of the foundation rails of the rectangular soleplate on mounting surfaces which are unsecured and cannot support the load Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▷ Use a concrete of compressive strength class C12/15 which meets the requirements of exposure class XC1 to EN 206-1. ▷ The mounting surface must have set and must be completely horizontal and even. ▷ 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.

5.3 Installing the pump set

Always install the pump set in a vertical position.

	 DANGER
	<p>Excessive temperatures due to improper installation Explosion hazard!</p> <ul style="list-style-type: none"> ▷ Install the pump in a vertical position to ensure self-venting of the pump.

Foundation


	 DANGER
	<p>Volute casing, pipe assembly and soleplate take on the same temperature as the fluid handled. Risk of burns!</p> <ul style="list-style-type: none"> ▷ Do not insulate the drive lantern and the bearing bracket lantern.

The sturdy soleplate 893 serves as a foundation on which the pump set is fastened. This soleplate covers the tank opening completely. If the pump set is supplied with a soleplate and riser, the soleplate is supported by a sectional steel frame to be fitted on the tank.


If pump and motor are delivered as separate units, transport and installation can be facilitated by screwing eyebolts into the threaded holes in the soleplate for attaching support ropes.


Grouting and aligning

1. Insert the foundation rail into the recess provided in the foundation block. Observe the dimensions given in the foundation drawing.
2. Align the foundation rail with a precision alignment tool. Any deviations should not exceed 0.1 mm/m.

	<div style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Improper installation Soleplate does not seal tightly any more.</p> <p>▷ Do not insert blocks for alignment if possible.</p>
---	---

3. After the concrete mixture has completely set, remove any concrete residues from the foundation rail and clean the area appropriately.
4. Place the gasket and soleplate onto the foundation block and fasten the soleplate. Do not crush, fold or otherwise damage the gasket.

	<div style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Improper installation of gasket Fluid or gas could escape!</p> <p>▷ Never install gasket incorrectly.</p>
---	--

	<div style="background-color: #0070c0; color: white; padding: 5px;">NOTE</div> <p>The tightness of the well can affect the $NPSH_A$ value due to the absence of atmospheric pressure. The operator should make sure that the $NPSH_A$ value exceeds the $NPSH_R$ value by 1 metre as a minimum.</p>
--	---

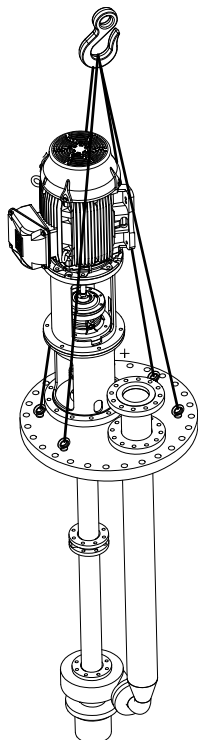
5. Verify that the soleplate is evenly seated on the foundation rail.

On the nozzle of a pressure vessel

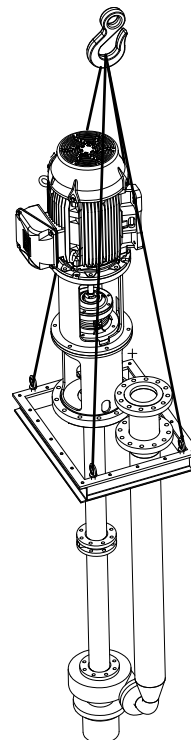
In this case the pump set is supplied mounted on a flange that will cover/close the pressure vessel.

1. Connect the flanges using standard procedures, i.e. parallel flange faces with a deviation of less than 0.5 mm and an alignment deviation of less than 0.1 mm/m.
2. Install the spiral wound gasket properly between the nozzles, making sure not to crush, fold or otherwise damage the spiral wound gasket.

Installing the pump set



Transporting a pump with a circular soleplate



Transporting a pump with a rectangular soleplate

1. Carefully align the support for the soleplate or the sectional steel frame.
2. If necessary, adjust the position of the soleplate in relation to the tank edge. Observe minimum distance $e1$ to the tank floor.

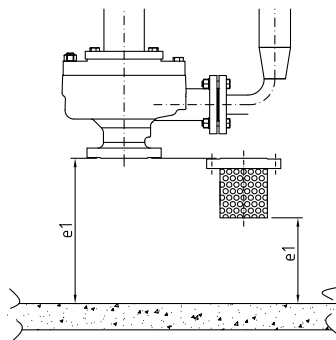


Fig. 5: Distance to the tank floor

Table 7: Distances to the tank floor

Size	$e1_{min}$
	[mm]
25-180	65
25-230	65
40-180	80
40-181	80
40-230	80
40-231	80
40-280	80
40-281	80
40-361	80
50-180	100

Size	e1 _{min} *
	[mm]
50-230	100
50-280	100
80-180	125
80-230	125
80-280	125



NOTE

Expansion joints can be fitted at the discharge nozzle.

5.4 Piping

5.4.1 Connecting the piping



DANGER

Impermissible loads acting on the pump nozzles

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

- ▷ Do not use the pump as an anchorage point for the piping.
- ▷ Anchor the pipes 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.
(⇒ Section 5.4.2, Page 25)
- ▷ Take appropriate measures to compensate for thermal expansion of the piping.



WARNING

Incorrect installation of packing rings

Fluid or gas could escape!

- ▷ Check that packing rings are correctly installed and sealing properly.



CAUTION

Welding 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 .





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 soleplate.
- ▷ Prevent current flowing through the rolling element bearings.

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

- ✓ The nominal sizes of the pipelines are equal to or greater than the nominal sizes of the pump nozzles.
 - ✓ Adapters to larger nominal diameters are designed with a diffuser angle of approx. 8° to avoid excessive pressure losses.
 - ✓ The pipelines are supported in close proximity to the discharge nozzle and have been connected without transmitting any stresses or strains. Their weight must not be carried by the discharge nozzle.
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 the flange cover on the pump discharge nozzle.
 3. Check that the inside of the pump is free from any foreign objects. Remove any foreign objects.
 4. Connect the discharge nozzle to the piping.

5.4.2 Permissible forces and moments at the discharge nozzle

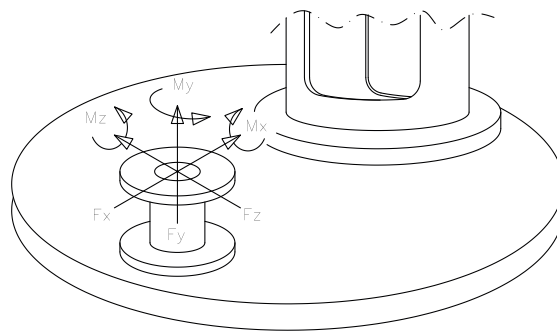


Fig. 6: Forces and moments at the discharge nozzle



Table 8: Forces and moments at the discharge nozzle⁶⁾

Size	Forces				Moments			
	F_x	F_y	F_z	F_{res}	M_x	M_y	M_z	M_{res}
	[N]				[Nm]			
25-180	710	580	890	1280	460	230	350	620
25-230	710	580	890	1280	460	230	350	620
40-180	1070	890	1330	1930	950	470	720	1280
40-181	1070	890	1330	1930	950	470	720	1280
40-230	1070	890	1330	1930	950	470	720	1280
40-231	1070	890	1330	1930	950	470	720	1280



⁶⁾ Specific values for a riser made of carbon steel

Size	Forces				Moments			
	F_x	F_y	F_z	F_{res}	M_x	M_y	M_z	M_{res}
	[N]				[Nm]			
40-280	1070	890	1330	1930	950	470	720	1280
40-281	1070	890	1330	1930	950	470	720	1280
40-361	1070	890	1330	1930	950	470	720	1280
50-180	1070	890	1330	1930	950	470	720	1280
50-230	1070	890	1330	1930	950	470	720	1280
50-280	1070	890	1330	1930	950	470	720	1280
80-180	2490	2050	3110	4480	2300	1180	1760	3130
80-230	2490	2050	3110	4480	2300	1180	1760	3130
80-280	2490	2050	3110	4480	2300	1180	1760	3130

5.4.3 Auxiliary connections

 	⚠ DANGER Risk of potentially explosive atmosphere by incompatible fluids mixing in the auxiliary piping Risk of burns! Explosion hazard! ▷ Make sure that the barrier fluid or quench liquid are compatible with the fluid handled.
	⚠ 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.

5.5 Enclosure/insulation

 	⚠ DANGER Risk of potentially explosive atmosphere due to insufficient ventilation Explosion hazard! ▷ Never close or cover the perforation of the bearing bracket guards (e.g. by insulation).
	⚠ WARNING The soleplate and discharge nozzle take on the same temperature as the fluid handled. Risk of burns! ▷ Fit protective equipment. ▷ Do not insulate the drive lantern and the bearing bracket lantern.

	<div style="background-color: #FFD700; padding: 5px;">CAUTION</div> <p>Heat build-up in the bearing bracket Damage to the bearings!</p> <ul style="list-style-type: none"> ▷ The bearing bracket must not be insulated.
--	--

5.6 Checking the coupling alignment

	<div style="background-color: #FF4500; padding: 5px;"> DANGER</div> <p>Inadmissible temperatures at the coupling or bearings due to misalignment of the coupling Explosion hazard! Risk of burns!</p> <ul style="list-style-type: none"> ▷ Make sure that the coupling is correctly aligned at all times.
--	--

	<div style="background-color: #FFD700; padding: 5px;">CAUTION</div> <p>Misalignment of pump and motor shafts Damage to pump, motor and coupling!</p> <ul style="list-style-type: none"> ▷ 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 soleplate.
--	---

Checking the coupling alignment with a dial gauge

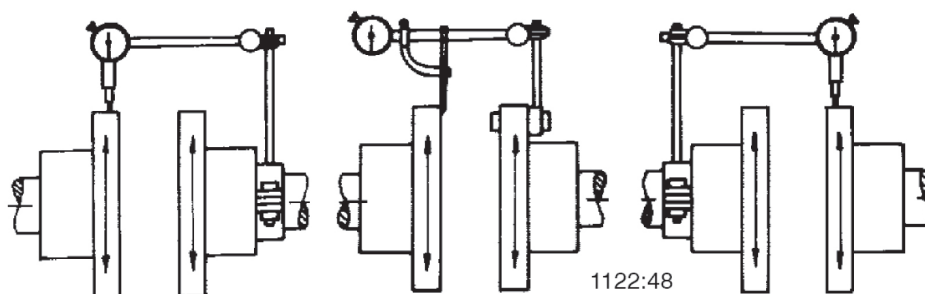


Fig. 7: Checking the spacer-type coupling with a dial gauge

1. Mark the installation position of the coupling by dotting marks (balance condition).
2. Remove the coupling spacer.

	<div style="background-color: #0070C0; color: white; padding: 5px;">NOTE</div> <p>While the pump's coupling is disengaged, also check the direction of rotation. (⇒ Section 5.9, Page 29)</p>
--	--


3. Check the alignment of the coupling halves with a dial gauge (see drawing "Checking the spacer-type coupling with a dial gauge").
The maximum admissible run-out of the coupling face (axial) equals 0.1 mm.
The maximum admissible radial deviation, measured over the complete circumference, equals 0.2 mm.

5.7 Aligning the pump and motor


After having installed the pump set and connected the piping, check the coupling alignment and, if required, re-align the pump set (with the motor).

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


1. Check the coupling alignment.
2. Loosen the hexagon head bolts at the motor.
3. Align the motor shaft with the pump shaft.
4. Re-tighten the hexagon head bolts.
5. 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! <ul style="list-style-type: none"> ▷ 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.

6. Fit the coupling guard and its footboard, if any.
7. Check the distance between coupling and coupling guard.
The coupling guard must not touch the coupling.


	⚠ DANGER
	Risk of ignition by frictional sparks Explosion hazard!! <ul style="list-style-type: none"> ▷ Choose a coupling guard material that is non-sparking in the event of mechanical contact.

5.8 Electrical connection


	⚠ DANGER
	Electrical connection work by unqualified personnel Risk of fatal injury due to electric shock! <ul style="list-style-type: none"> ▷ Always have the electrical connections installed by a trained and qualified electrician. ▷ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.

	⚠ WARNING
	Incorrect connection to the mains Damage to the mains network, short circuit! <ul style="list-style-type: none"> ▷ 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 starting method.

	NOTE
	Installing a motor protection device is recommended.

5.8.1 Earthing




	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Electrostatic charging Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Connect the PE conductor to the earthing terminal provided. ▷ Provide for potential equalisation between the pump set and the foundation.
---	---

5.8.2 Connecting the motor

	<div style="background-color: #0072bc; color: white; padding: 5px;">NOTE</div> <p>In compliance with IEC 60034-8, three-phase motors are always wired for clockwise rotation (looking at the motor shaft stub). The pump's direction of rotation is indicated by an arrow on the pump.</p>
---	---

1. Match the motor's direction of rotation to that of the pump.
2. Observe the manufacturer's product literature supplied with the motor.

5.9 Checking the direction of rotation

	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Temperature increase resulting from contact between rotating and stationary components Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ 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.
	<div style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Reaching into a tank whose soleplate has been removed Risk of injuries!</p> <ul style="list-style-type: none"> ▷ When the soleplate is removed, never reach into the uncovered tank opening.
	<div style="background-color: #f4d03f; padding: 5px;">CAUTION</div> <p>Drive and pump running in the wrong direction of rotation Damage to the pump!</p> <ul style="list-style-type: none"> ▷ 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 correct direction of rotation of the motor and pump is clockwise (seen from the motor end).

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 is running in the wrong direction of rotation, check the electrical connection of the motor and the control system, if applicable.

6 Commissioning/Start-up/Shutdown

6.1 Commissioning/Start-up

6.1.1 Prerequisites for commissioning/start-up

Before commissioning/starting up the pump set, make sure that the following conditions are met:

- The pump set has been mechanically connected as specified.
- The pump set has been properly connected to the power supply and is equipped with all protection devices. (⇒ Section 5.8, Page 28)
- The pump has been primed with the fluid to be handled. The pump has been vented. (⇒ Section 6.1.4, Page 32)
- The direction of rotation has been checked. (⇒ Section 5.9, Page 29)
- All auxiliary connections required are connected and operational.
- The lubricants have been checked.
- After prolonged shutdown of the pump (set), the activities required for returning the equipment to service have been carried out.


6.1.2 Filling in the lubricant

Oil-lubricated bearings Fill the bearing bracket with lubricating oil.

- Oil quality (⇒ Section 7.2.3.1.2, Page 43)
- Oil quantity (⇒ Section 7.2.3.1.3, Page 43)

Filling the constant level oiler with lubricating oil (oil-bath-lubricated bearings only)

- ✓ The constant level oiler has been screwed into the upper tapping hole of the bearing bracket.

	<p style="background-color: yellow; margin: 0;">CAUTION</p> <p>Insufficient quantity of lubricating oil in the reservoir of the constant level oiler Damage to the bearings!</p> <ul style="list-style-type: none"> ▷ Regularly check the oil level. ▷ Always fill the oil reservoir completely.
---	--

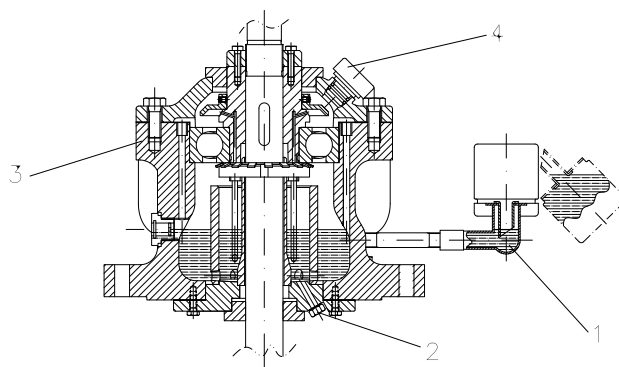


Fig. 8: Bearing bracket with constant level oiler

1	Constant level oiler	2	Screw plug
3	Bearing bracket	4	Vent plug

1. Remove the protective cage.
2. Unscrew the vent plug (4).
3. Hinge down the reservoir of the constant level oiler (1) from the bearing bracket (3) and hold it in this position.

4. Fill oil through the hole for the vent plug until the oil reaches the connection elbow of the constant level oiler (1).
5. Completely fill the reservoir of the constant level oiler (1).
6. Snap the constant level oiler (1) back into its operating position.
7. Screw the vent plug (4) back in.
8. Fit the protective cage.
9. After approximately 5 minutes, check the oil level in the glass reservoir of the constant level oiler (1).
The oil reservoir must be properly filled at all times to provide a constant oil level. Repeat steps 1 - 8 if necessary.
10. To check the function of the constant level oiler (1), slowly drain some oil via the screw plug (2) until air bubbles can be seen in the oil reservoir.



NOTE

An excessively high oil level can lead to a temperature rise and to leakage of the fluid handled or oil.

Connecting the oil mist lubrication system (for oil mist lubrication only)

Bearings with oil mist lubrication

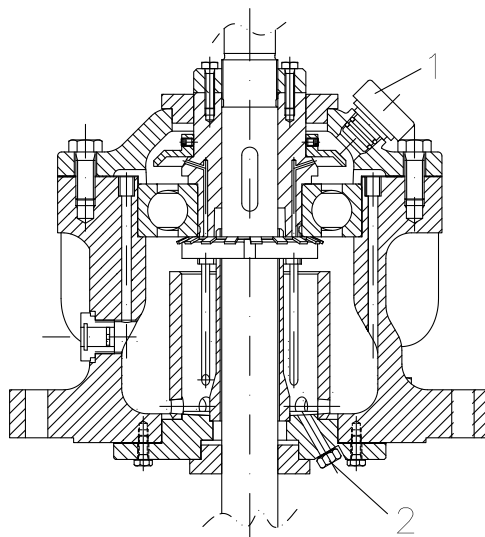


Fig. 9: Oil mist lubrication

1	Plug	2	Drain plug
---	------	---	------------

- ✓ Always observe the instructions of the lubricating system manufacturer (especially on dosing and oil quantity).

1. Remove plug 1.
2. Connect the line of the oil mist lubrication system.
3. Remove drain plug 2.
4. Connect the drain line (returning the oil back into the oil mist system).

6.1.3 Shaft seal

Shaft seals are fitted prior to delivery.

Observe the instructions on dismantling or assembly (⇒ Section 7.5, Page 47) .

Quench reservoir

If applicable, fill the quench reservoir in accordance with the general arrangement drawing.








Double mechanical seal

Prior to starting up the pump, apply barrier pressure as specified in the general arrangement drawing.

External liquid feed

Apply the quantities and pressures specified in the data sheet and the general arrangement drawing.

6.1.4 Priming and venting the pump


	<div data-bbox="507 232 639 264" style="background-color: #FFD700; padding: 5px;">CAUTION</div> <p>Increased wear due to dry running Damage to the pump/plain bearing!</p> <ul style="list-style-type: none"> ▷ Never operate the pump set without liquid fill. ▷ Never supply the pump with cold fluid after dry running.
<p>During pump start-up and operation, the fluid level must be above the minimum level. The minimum fluid level is indicated in the type series booklet or the general arrangement drawing.</p>	
	<div data-bbox="507 575 683 629" style="background-color: #FF4500; padding: 5px;"> DANGER</div> <p>Risk of potentially explosive atmosphere by incompatible fluids mixing in the auxiliary piping Risk of burns! Explosion hazard!</p> <ul style="list-style-type: none"> ▷ Make sure that the barrier fluid or quench liquid are compatible with the fluid handled.
	<div data-bbox="507 878 683 931" style="background-color: #FF4500; padding: 5px;"> DANGER</div> <p>Formation of a potentially explosive atmosphere inside the pump Explosion hazard!</p> <ul style="list-style-type: none"> ▷ The pump internals in contact with the fluid handled, including the seal chamber and auxiliary systems, must be filled with the fluid handled at all times. ▷ Make sure the required fill level is met. ▷ Provide an appropriate monitoring system.
	<div data-bbox="507 1220 683 1274" style="background-color: #FF4500; padding: 5px;"> DANGER</div> <p>Shaft seal failure caused by insufficient lubrication Leakage of hot or toxic fluid handled! Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Before starting up the pump set, vent the pump and fill it with the fluid to be handled.

1. Vent the pump and prime it with the fluid to be handled.
2. Fully open all auxiliary connections (barrier fluid, flushing liquid, etc.).

6.1.5 Final check

1. Remove the coupling guard and its footboard, if any.
2. Check the coupling alignment; re-align the coupling, if required.
3. Check proper functioning of coupling/shaft.
Check that coupling/shaft can be easily rotated by hand.
4. Fit the coupling guard and its footboard, if any.
5. Check the distance between coupling and coupling guard.
The coupling guard must not touch the coupling.


6.1.6 Water cooling


	CAUTION
	<p>Deposit-forming, aggressive cooling water Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Observe the cooling water quality.

Observe the following quality data of the cooling water:




- Not deposit-forming
- Not aggressive
- Free from suspended solids
- Hardness on average 5 °dH (~1 mmol/l)
- pH > 8
- Conditioned and neutral with regard to mechanical corrosion
- Inlet temperature $t_{inl}=10$ to 30 °C
Outlet temperature $t_{outl}= 45$ °C max.

6.1.7 Cooling of the shaft seal




	CAUTION
	<p>Vaporisation pressure of fluid handled higher than atmospheric pressure Damage to the shaft seal/pump!</p> <ul style="list-style-type: none"> ▷ Cool the shaft seal. ▷ Provide sufficient quantities of cooling liquid (see table).


	NOTE
	<p>The vaporisation pressure varies depending on the fluid handled, the system pressure and the material of the shaft seal (e.g. hot water).</p>


6.1.8 Heating

 	 DANGER
	<p>Excessive surface temperature Explosion hazard! Risk of burns!</p> <ul style="list-style-type: none"> ▷ Observe the permissible temperature classes.


6.1.9 Start-up

 	 DANGER
	<p>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!</p> <ul style="list-style-type: none"> ▷ 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.


	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Excessive temperatures due to dry running or excessive gas content in the fluid handled</p> <p>Explosion hazard!</p> <p>Damage to the pump set!</p> <ul style="list-style-type: none"> ▸ Never operate the pump set without liquid fill. ▸ Prime the pump as per operating instructions. ▸ Always operate the pump within the permissible operating range.
---	---

	<div style="background-color: #f4d03f; padding: 5px;">CAUTION</div> <p>Abnormal noises, vibrations, temperatures or leakage</p> <p>Damage to the pump!</p> <ul style="list-style-type: none"> ▸ Switch off the pump (set) immediately. ▸ Eliminate the causes before returning the pump set to service.
---	---

- ✓ The system piping has been cleaned.
- ✓ The pump, suction line and inlet tank, if fitted, have been vented and primed with the fluid to be pumped.
- ✓ The fill level of the fluid to be pumped has been checked.

	<div style="background-color: #f4d03f; padding: 5px;">CAUTION</div> <p>Start-up against open discharge line</p> <p>Motor overload!</p> <ul style="list-style-type: none"> ▸ Make sure the motor has sufficient power reserves. ▸ Use a soft starter. ▸ Use speed control.
---	--

1. Close or slightly open the shut-off element in the discharge line.
2. Start up the motor.
3. Immediately after the pump has reached rated speed, slowly open the shut-off element in the discharge line and adjust it to comply with the duty point.

	<div style="background-color: #f4d03f; padding: 5px;">CAUTION</div> <p>Misalignment of pump and coupling</p> <p>Damage to pump, motor and coupling!</p> <ul style="list-style-type: none"> ▸ When the operating temperature has been reached, switch off the pump set and check the coupling alignment.
---	--


4. Check the coupling alignment and re-align the coupling, if required.


6.1.10 Checking the shaft seal

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

6.1.11 Shutdown


- ✓ On pump sets with double mechanical seal, apply the required pressure specified in the general arrangement drawing to the mechanical seal chamber also during standstill.
- ✓ Quench liquid supply must also be ensured during pump standstill.
 1. Close the shut-off element in the discharge line.
 2. Stop the motor and make sure the pump set runs down smoothly to a standstill.

	<p>NOTE</p> <p>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.</p>
---	--



	<p>NOTE</p> <p>If shut-off is not possible, the pump will run in reverse direction. The reverse runaway speed must be lower than the rated speed.</p>
---	--


For prolonged shutdown periods:

1. Close any auxiliary lines.
If the fluid to be handled is fed in under vacuum, also supply the shaft seal with barrier fluid during standstill.
Only turn off the cooling liquid supply after the pump has cooled down.


	<p>CAUTION</p> <p>Risk of freezing during prolonged pump shutdown periods</p> <p>Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Drain the pump and the cooling/heating chambers (if any) or otherwise protect them against freezing.
---	---

6.2 Operating limits

 	<p>⚠ DANGER</p> <p>Non-compliance with operating limits for pressure, temperature, fluid handled and speed</p> <p>Explosion hazard! Hot or toxic fluid could escape!</p> <ul style="list-style-type: none"> ▷ 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 speeds exceeding those indicated in the data sheet, on the name plate or in unless the written consent of the manufacturer has been obtained.
--	--

	<p>⚠ DANGER</p> <p>Formation of a potentially explosive atmosphere inside the pump</p> <p>Explosion hazard!</p> <ul style="list-style-type: none"> ▷ When draining tanks take suitable measures to prevent dry running of the pump (e.g. fill level monitoring).
---	---

6.2.1 Ambient temperature



	CAUTION
	Operation outside the permissible ambient temperature Damage to the pump (set)! ▷ Observe the specified limits for permissible ambient temperatures.

Observe the following parameters and values during operation:

Table 9: Permissible ambient temperatures

Permissible ambient temperature	Value
Maximum	50 °C 40 °C ⁷⁾
Minimum	See data sheet


6.2.2 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.

The frequency of starts is determined by the maximum temperature increase of the motor. The frequency of starts depends on the power reserves of the motor in steady-state operation and on the starting conditions (DOL starting, star-delta starting, moments of inertia, etc). If the start-ups are evenly spaced over the period indicated, the following limits serve as orientation for start-up with the discharge-side shut-off valve slightly open:

Table 10: Frequency of starts

Motor rating	Maximum frequency of starts
[kW]	[Starts/hour]
≤ 12	15
≤ 100	10
> 100	5

	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.

6.2.3 Fluid handled

6.2.3.1 Flow rate

Unless specified otherwise in the characteristic curves or in the data sheets, the following applies:

$Q_{\max}^{8)}$ See characteristic curves.

⁷⁾ For compliance with 2014/34/EU (ATEX Equipment Directive). Higher ambient temperature possible in individual cases, see data sheet and name plate.

⁸⁾ Maximum permissible flow rate

$$Q_{\min}^{9)} = 0.3 \times Q_{\text{opt}}^{10)}$$

The data refer to water and water-like fluids. Longer operating periods with these fluids and at the flow rates indicated will not cause an additional increase in the temperatures on the pump surface. However, if the physical properties of the fluids handled differ from those of water, the calculation formula below must be used to check if an additional heat build-up may lead to a dangerous temperature increase at the pump surface. If necessary, the minimum flow must be increased.

$$T_O = T_f + \Delta \vartheta$$


$$\Delta \vartheta = \frac{g \times H}{c \times \eta} \times (1 - \eta)$$

Table 11: Key

Symbol	Description	Unit
c	Specific heat capacity	J/kg K
g	Acceleration due to gravity	m/s ²
H	Pump discharge head	m
T _f	Fluid temperature	°C
T _O	Temperature at the casing surface	°C
η	Pump efficiency at duty point	-
Δϑ	Temperature difference	K

6.2.3.2 Density of the fluid handled

The power input of the pump set will change in proportion to the density of the fluid handled.

	<div style="background-color: #FFD700; padding: 5px;">CAUTION</div> <p>Impermissibly high density of the fluid handled</p> <p>Motor overload!</p> <ul style="list-style-type: none"> ▷ Observe the information about fluid density in the data sheet. ▷ Make sure the motor has sufficient power reserves.
---	--

6.2.3.3 Abrasive fluids

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.

6.3 Shutdown/storage/preservation

6.3.1 Measures to be taken for shutdown

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.

⁹ Minimum permissible flow rate

¹⁰ Best efficiency point

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





- ✓ The pump has been properly drained.
 - ✓ The safety instructions for dismantling the pump have been 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 or grease, food-approved if required) to protect them against corrosion.
- Observe the additional instructions on preservation. (⇒ Section 3.3, Page 14)

If the pump set is to be stored temporarily, only preserve the wetted components made of low-alloy materials. Commercially available preservatives can be used for this purpose. Observe the manufacturer's instructions for application/removal.

6.4 Returning to service












For returning the pump to service, observe the items on commissioning/start-up (⇒ Section 6.1, Page 30) and the operating limits (⇒ Section 6.2, Page 35) .

In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇒ Section 7, Page 39)


	<div style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <div style="padding: 5px;"> 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. </div>
	<div style="background-color: #0072bc; color: white; padding: 5px;">NOTE</div> <div style="padding: 5px;"> If the equipment has been out of service for more than one year, replace all elastomer seals. </div>
	<div style="background-color: #0072bc; color: white; padding: 5px;">NOTE</div> <div style="padding: 5px;"> The pump is protected against splashing water as the covers of the thrust bearings are water-tight. </div>
	<div style="background-color: #0072bc; color: white; padding: 5px;">NOTE</div> <div style="padding: 5px;"> Observe the relevant manufacturer's product literature for the motor. </div>

7 Servicing/Maintenance

7.1 Safety regulations

	<div data-bbox="507 315 683 360"> DANGER</div> <div data-bbox="496 380 991 409">Improper cleaning of coated pump surfaces</div> <div data-bbox="496 416 991 445">Explosion hazard by electrostatic discharge!</div> <div data-bbox="518 456 1406 515"> <ul style="list-style-type: none"> ▷ When cleaning coated pump surfaces in atmospheres of Explosion group IIC, use suitable anti-static equipment. </div>
	<div data-bbox="507 551 683 595"> DANGER</div> <div data-bbox="496 616 943 645">Sparks produced during servicing work</div> <div data-bbox="496 651 699 680">Explosion hazard!</div> <div data-bbox="518 692 1437 792"> <ul style="list-style-type: none"> ▷ Observe the safety regulations in force at the place of installation! ▷ Always perform maintenance work at an explosion-proof pump (set) outside of potentially explosive atmospheres. </div>
 	<div data-bbox="507 831 683 875"> DANGER</div> <div data-bbox="496 896 836 925">Improperly serviced pump set</div> <div data-bbox="496 931 699 960">Explosion hazard!</div> <div data-bbox="496 967 788 996">Damage to the pump set!</div> <div data-bbox="518 1008 1430 1108"> <ul style="list-style-type: none"> ▷ Service the pump set regularly. ▷ Prepare a maintenance schedule with special emphasis on lubricants, shaft seal and coupling. </div>
	<div data-bbox="507 1249 703 1294"> WARNING</div> <div data-bbox="496 1314 940 1344">Unintentional starting of the pump set</div> <div data-bbox="496 1350 1139 1379">Risk of injury by moving components and shock currents!</div> <div data-bbox="518 1391 1414 1491"> <ul style="list-style-type: none"> ▷ 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. </div>
	<div data-bbox="507 1525 703 1570"> WARNING</div> <div data-bbox="496 1590 1378 1648">Fluids handled, consumables and supplies which are hot and/or pose a health hazard</div> <div data-bbox="496 1655 654 1684">Risk of injury!</div> <div data-bbox="518 1695 1430 1839"> <ul style="list-style-type: none"> ▷ 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. </div>

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

	⚠ WARNING
	Insufficient stability Risk of crushing hands and feet! <ul style="list-style-type: none"> ▷ 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. For contact details please refer to the enclosed "Addresses" booklet or visit " www.ksb.com/contact " on the Internet.



Never use force when dismantling and reassembling the pump set.



7.2 Servicing/Inspection

7.2.1 Supervision of operation

 	⚠ 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! <ul style="list-style-type: none"> ▷ Regularly check the lubricant level. ▷ Regularly check the rolling element bearings for running noises.


 	⚠ DANGER
	Incorrectly serviced shaft seal Explosion hazard! Hot, toxic fluid escaping! Damage to the pump set! Risk of burns! Fire hazard! <ul style="list-style-type: none"> ▷ Regularly service the shaft seal.

 	⚠ DANGER
	Incorrectly serviced barrier fluid system Explosion hazard! Fire hazard! Damage to the pump set! Hot and/or toxic fluids escaping! <ul style="list-style-type: none"> ▷ Regularly service the barrier fluid system. ▷ Monitor the barrier fluid pressure.


	CAUTION
	<p>Increased wear due to dry running Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Never operate the pump set without liquid fill.
	CAUTION
	<p>Impermissibly high temperature of fluid handled Damage to the pump!</p> <ul style="list-style-type: none"> ▷ 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 35)

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

- The pump must run quietly and free from vibrations at all times.
- In case of oil lubrication, ensure the oil level is correct.
- Check the shaft seal.
- 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.
- Cooling system
Take the pump out of service at least once a year to thoroughly clean the cooling system.
- Monitor the stand-by pump.
To make sure that the 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).

	CAUTION
	<p>Operation outside the permissible bearing temperature Damage to the pump!</p> <ul style="list-style-type: none"> ▷ The bearing temperature of the pump (set) must never exceed 90 °C (measured on the outside of the bearing bracket).

7.2.2 Inspection work

	⚠ DANGER
	<p>Excessive temperatures caused by friction, impact or frictional sparks Explosion hazard! Fire hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Regularly check the coupling guard, plastic components and other guards of rotating parts for deformation and sufficient distance from rotating parts.

7.2.2.1 Checking the coupling

Check the flexible elements of the coupling. Replace the relevant parts in due time if there is any sign of wear and check the alignment.

7.2.2.2 Checking the clearances

Impeller

For checking the clearances remove impeller 230 if required .

If the clearance is larger than permitted, fit a new casing wear ring 502.01 and/or impeller wear ring 503.01.

The clearances given refer to the diameter.

Table 12: Clearances between impeller and casing


Size	Suction-side casing wear ring		
	Inner nominal diameter (rounded)	Minimum clearance to API 610	Clearance to AN 1501 Gr. 2 (standard)
	[mm]	[mm]	[mm]
25-180	70	0,3	0,5
25-230	70	0,3	0,5
40-180	80	0,33	0,5
40-181	95	0,35	0,6
40-230	80	0,33	0,5
40-231	95	0,35	0,6
40-280	85	0,33	0,6
40-281	95	0,35	0,6
40-361	95	0,35	0,6
50-180	120	0,4	0,6
50-230	120	0,4	0,6
50-280	120	0,4	0,6
80-180	135	0,43	0,6
80-230	135	0,43	0,6
80-280	135	0,43	0,6

Plain bearing

The clearances between bearing sleeve 529, shaft protecting sleeve 524 and bearing bush 545 must measure between 0.2 mm and 0.3 mm. If these values are not met the components should be replaced. Observe the fastening method for the bushes given in the sectional drawing/general assembly drawing. The shrinking properties of specific bush materials require bonding agents and grub screw to be used.


The sleeves can be machined to eliminate any superficial defects provided that the permissible clearance is maintained.

7.2.2.3 Cleaning the strainer

	CAUTION
	<p>Insufficient inlet pressure due to clogged strainer in the suction line</p> <p>Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Monitor contamination of strainer with suitable means (e.g. differential pressure gauge). ▷ Clean the strainer at appropriate intervals.

1308.83/03-EN

7.2.3 Lubrication and lubricant change of rolling element bearings

	<div style="background-color: #e67e22; color: white; padding: 5px;">⚠ DANGER</div> <p>Excessive temperatures as a result of bearings running hot or defective bearing seals</p> <p>Explosion hazard!</p> <p>Fire hazard!</p> <p>Damage to the pump set!</p> <p>► Regularly check the condition of the lubricant.</p>
---	---

7.2.3.1 Oil lubrication

The rolling element bearings are usually lubricated with mineral oil.

7.2.3.1.1 Intervals

Table 13: Oil change intervals

Temperature at the bearing	First oil change	All subsequent oil changes ¹¹⁾
Up to 70 °C	After 300 operating hours	Every 8500 operating hours
70 °C - 80 °C	After 300 operating hours	Every 4200 operating hours
80 °C - 90 °C	After 300 operating hours	Every 2000 operating hours

7.2.3.1.2 Oil quality

Oil quality Table 14: Oil quality

Designation	Symbol to DIN 51502	Characteristics	
CLP46 lubricating oil to DIN 51517 or HD 20W/20 SAE	□	Kinematic viscosity at 40 °C	46±4 mm ² /s
		Flash point (to Cleveland)	+175 °C
		Solidification point (pour point)	-15 °C
		Application temperature ¹²⁾	Higher than permissible bearing temperature



7.2.3.1.3 Oil quantity

Bearing bracket	Oil quantity bearing bracket
	[l]
B02	0,75

¹¹⁾ At least once a year

¹²⁾ For ambient temperatures below -10 °C use a different suitable type of lubricating oil. Contact KSB.

7.2.3.1.4 Changing the oil

	 WARNING
	<p>Lubricants posing a health hazard and/or hot lubricants</p> <p>Hazard to persons and the environment!</p> <ul style="list-style-type: none"> ▷ When draining the lubricant take appropriate measures to protect persons and the environment. ▷ Wear safety clothing and a protective mask if required. ▷ Collect and dispose of any lubricants. ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

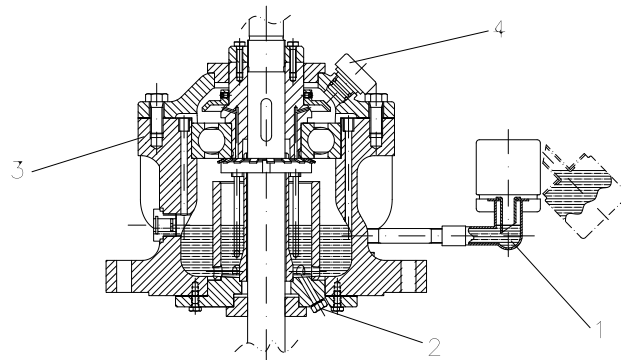


Fig. 10: Bearing bracket with constant level oiler




1	Constant level oiler	2	Screw plug
3	Bearing bracket		

✓ A suitable container for the used oil is on hand.



1. Place the container underneath the screw plug.
2. Undo the screw plug (2) at the bearing bracket (3) and drain the oil.
3. Once the bearing bracket (3) has been drained, re-insert and re-tighten the screw plug (2).
4. Re-fill with oil.

7.2.4 Radial bearings

In the volute casing and the support column assembly the shaft is guided in plain bearings lubricated by the fluid handled. If the fluid handled is contaminated, the bearings can be lubricated by an external liquid supplied via a lubrication line (special design).

 	 DANGER
	<p>Clogged holes in the lubrication line</p> <ul style="list-style-type: none"> ▷ Regularly check and clean the small holes in the lubrication lines.







7.3 Drainage/cleaning

	 WARNING
	<p>Fluids handled, consumables and supplies which are hot and/or pose a health hazard</p> <p>Hazard to persons and the environment!</p> <ul style="list-style-type: none"> ▷ 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.

7.4 Dismantling the pump set

7.4.1 General information/Safety regulations



	 WARNING
	<p>Unqualified personnel performing work on the pump (set)</p> <p>Risk of injury!</p> <ul style="list-style-type: none"> ▷ Always have repair work and maintenance work performed by specially trained, qualified personnel.
	 WARNING
	<p>Hot surface</p> <p>Risk of injury!</p> <ul style="list-style-type: none"> ▷ Allow the pump set to cool down to ambient temperature.
	 WARNING
	<p>Improper lifting/moving of heavy assemblies or components</p> <p>Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

Always observe the safety instructions and information. (⇒ Section 7, Page 39)

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

For dismantling and reassembly refer to the general assembly drawing.
(⇒ Section 9.1, Page 55)



In case of damage you can always contact our service staff.

	 DANGER
	<p>Insufficient preparation of work on the pump (set) Risk of personal injury!</p> <ul style="list-style-type: none"> ▷ Properly shut down the pump set. ▷ Close the shut-off elements in the discharge line. ▷ Drain the pump and release the pump pressure. ▷ Close any auxiliary connections. ▷ Allow the pump set to cool down to ambient temperature.

7.4.2 Preparing the pump set

1. Interrupt the power supply and make sure it cannot be switched on again unintentionally.
2. Disconnect and remove all auxiliary pipework.
3. Remove the coupling guard.
4. Remove the coupling spacer if fitted.
5. Drain the oil fill of oil-lubricated bearings.

7.4.3 Removing the complete pump set from the piping



	 WARNING
	<p>Leakage of residual liquid from the pump Hazard to persons and the environment!</p> <ul style="list-style-type: none"> ▷ Take suitable precautions when draining, collecting and disposing of fluids handled. ▷ Observe the information on draining and cleaning.

1. Disconnect any auxiliary lines.
2. Separate soleplate 893 from foundation rail 89-8 or from the pressure vessel nozzle.
3. Remove the pump set and soleplate/flange from the sump or tank.
4. Place it down in a horizontal position.
5. Remove the coupling guard.
6. Disconnect the coupling and remove the motor.
7. Undo the screw for fastening the coupling hub.
8. Remove the coupling half of the pump shaft.
9. Remove key 940.1.
10. Undo the connection between the motor and drive lantern 341. Remove the motor.
11. Remove constant level oiler 638 and pipe 710.7, if any.
12. Undo bolts 901.9.
13. Remove drive lantern 341 from bearing bracket lantern 344.
14. Remove adjusting nut 923.2.
15. Loosen and remove bolts 901.3 for fastening bearing cover 360.
16. Use a puller to remove centring sleeve 526 with bearing 321.
17. Remove key 940.2. Undo bolts 901.11. Separate drive shaft 213 and intermediate coupling 848.
18. Loosen bolts 901.5 and remove bearing housing 350.
19. Undo nuts 920.13.

20. Remove mechanical seal 433.
21. Undo nuts 920.17 and studs 902.17.
22. Remove bearing bracket lantern 344 from soleplate 893 or the flange, depending on the seal plan and piping layout. First of all, check if the pipes could be hit in this step. If this is the case, remove the pipes first.
23. Separate pipes 710 at their connections 720.
24. Remove nuts 920.19 and bolts 901.33 from riser spool 711.1/.2 and discharge elbow 144.
25. Remove the riser and the discharge elbow.
26. Position the pump on a wooden block.
27. Separate pipe assembly 712 from soleplate 893 or the flange.
28. Remove nuts 920.18.
29. Lift the soleplate with a crane.
30. Disconnect pipe assembly 713 with conical coupling 853.
31. Continue dismantling pipe assembly 713.
32. Remove intermediate shaft 212 and pump shaft 211, which are connected by conical coupling 851.
33. Remove bearing sleeves 529, which are radially fastened by grub screws 904, from the shaft.
34. Separate volute casing 102 from discharge cover 161.
35. Remove pump shaft 211 together with impeller 230.
36. Remove spiral wound gasket 411.31.
37. Undo impeller nut 922.
38. Pull off impeller 230 together with gaskets 411.
39. Remove key 940.5, joint ring 400.33 and shaft protecting sleeve 524.
40. If bearing bush 545.27 needs to be removed from discharge cover 161, use a puller.
41. Bearing bush 545 can be removed from support column 713 by means of a press.


7.5 Reassembling the pump set

7.5.1 General information/Safety regulations

	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.
	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.

Sequence Always reassemble the pump in accordance with the corresponding general assembly drawing.



- Sealing elements**
- **Gaskets**
 - Always use new gaskets, making sure that they have the same thickness as the old ones.
 - Always fit gaskets of asbestos-free materials or graphite without using lubricants (e.g. copper grease, graphite paste).
 - **O-rings**
 - Never use O-rings that have been made by cutting an O-ring cord to size and gluing the ends together.

	<div style="background-color: #FFD700; padding: 5px;">CAUTION</div> <p>Contact of O-ring with graphite or similar material Fluid could escape!</p> <ul style="list-style-type: none"> ▷ Do not coat O-ring with graphite or similar material. ▷ Use animal fats or lubricants based on silicone or PTFE.
---	--

- **Assembly adhesives**
 - For gaskets, avoid the use of assembly adhesives if possible.
 - If assembly adhesives are required, use a commercially available contact adhesive (e.g. "Pattex").
 - Only apply adhesive at selected points and in thin layers.
 - Never use quick-setting adhesives (cyanoacrylate adhesives).
 - Coat the locating surfaces of the individual components and screwed connections with graphite or similar before reassembly.
 - Prior to reassembly, screw back any forcing screws and adjusting screws.

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

7.5.2 Underfloor installation / Installing the bearing bracket lantern

	<div style="background-color: #0070C0; color: white; padding: 5px;">NOTE</div> <p>Always replace gaskets 400 and O-rings 412 with new ones for reassembly.</p>
	<div style="background-color: #0070C0; color: white; padding: 5px;">NOTE</div> <p>Impeller nut 922 is fastened with a HeliCoil thread insert. For safety reasons KSB recommends replacing the nut after every 3rd or 4th disassembly.</p>

1. Fit shaft protecting sleeve 524, joint ring 400.33, key 940.5, impeller 230, gaskets 411 and impeller nut 922 on pump shaft 211.
2. Insert the assembly of pump shaft 211 into volute casing 102.
3. Insert spiral wound gasket 411.31 into discharge cover 161.
4. In the following order fit support column 712, bearing sleeve 529.21 and bearing spider 383.21.
5. Slide intermediate shaft 212 with inserted segmental rings 501 towards pump shaft 211 until the two shafts abut each other.
6. Fasten with conical coupling 851 and studs 902.22.
7. Mount bearing bracket lantern 344 on soleplate 893 or flange.
8. Position support column 712 and bearing spider 383.15.
9. Fasten to bearing bracket lantern 344 or pipe assembly 712.

10. Connect riser spool 711.2 to the soleplate or flange.
11. Connect pipes 710 to fittings 720.

7.5.3 Installing the mechanical seal

- ✓ Utmost caution and cleanliness during installation are decisive for trouble-free operation of the mechanical seal.
 - ✓ The protective wrapping of the contact faces shall only be removed immediately before assembly takes place.
1. After inserting the mating ring, check that it is plane-parallel in relation to the casing part. The maximum deviation equals 0.02 mm.
 2. The surface of the shaft protecting sleeve must be absolutely clean and smooth, and the sleeve's mounting edge must be chamfered.
 3. When sliding the rotating assembly onto the shaft protecting sleeve, take appropriate steps to protect the surface of the shaft protecting sleeve from damage.
 4. On pumps with double mechanical seal the mechanical seal chamber must be properly vented and the required pressure specified in the general arrangement drawing must be applied (also during standstill). Quench liquid supply must also be ensured during pump standstill.

7.5.4 Above-floor installation

1. Pull the half of intermediate coupling 848 onto the end of the last intermediate shaft 213.
2. Fit key 940.3, washer 550.11 and bolt 901.11.
3. Heat the bearing and inner spacer ring 504.2 up to 80 °C by means of an induction heater or in an oil bath.
4. Pull inner spacer ring 504.2 onto centring sleeve 526.
5. Insert lock washer 931.
6. Fit and tighten bearing nut 923. Secure it with the lock washer.
7. Fit oil thrower 508.
8. Fasten the lower bearing cover 360.1 or bearing housing 350 and gasket 400.5 to bearing bracket lantern 344.
9. Insert inner spacer ring 504.1 into bearing housing 350.
10. Insert the assembly consisting of spacer sleeve and bearing.
11. Insert drive shaft 213 and key 940.2 into the spacer sleeve.
12. Fasten thrower 507, if applicable, and the bearing guard to the lower bearing cover.
13. Align it with intermediate coupling 848.
14. Secure ring 500.
15. Fit the upper part of the spacer sleeve of the intermediate coupling. Fasten it with bolts 901.12.
16. Fit gasket 400.3, thrower 507 (if applicable) and bearing guard 423.1.
17. Close the thrust bearing with upper bearing cover 360.
18. Prior to connecting the motor via the coupling, adjust the axial clearance.
19. Adjust the axial clearance between impeller 230 and discharge cover 161 with adjusting nut 923.2.
20. Tighten adjusting nut 923.2 until the impeller abuts the discharge cover.
21. Use a depth gauge to lower the rotor by 2.5 mm with the surfaces of the shaft end and the adjusting nut serving as reference dimensions.
22. Fasten drive lantern 341 in bearing bracket 344 with bolts 901.9.
23. Fit key 940.1 and the lower half of coupling 840 on the shaft. Fasten them with a grub screw.

24. Suspend the pump set by eyebolts 900.2. Place it down on foundation rail 89-8 or the pressure vessel nozzle. Fasten it with nuts 920.18.

25. Connect motor 801 via the coupling. Fasten it to drive lantern 341.



NOTE

Pumps with support columns of more than 3 metres length should be assembled in the well. Observe the sequence described.

7.6 Tightening torques

7.6.1 Tightening torques for the pump

Table 15: Tightening torques [Nm]¹³⁾¹⁴⁾

Size	Stud (casing)	Stud (cover)	Hexagon head bolt (bearing bracket)	Stud (seal cover)	Impeller nut
	Part No.				
	902.31	901.29	901.3	902.13	922
	Material				
	Steel A193 Gr. B7	SAE 1045 8.8	Steel A193 Gr. B7	AISI 316	AISI 316
25-180	163	120	40	50	80
25-230	163	120	40	50	80
40-180	163	120	40	50	80
40-181	163	120	40	50	130
40-230	163	120	40	50	80
40-231	163	120	40	50	130
40-280	330	120	40	50	130
40-281	330	120	40	50	130
40-361	330	120	40	50	130
50-180	330	120	40	50	130
50-230	330	120	40	50	130
50-280	330	120	40	50	130
80-180	163	120	40	50	130
80-230	330	120	40	50	130
80-280	330	120	40	50	130

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. (⇒ Section 4.3, Page 16)

¹³ These values are determined on the basis of a friction coefficient $\mu = 0.12$.

¹⁴ After repeated tightening of the threads and in case of good lubrication the values shall be reduced by 15 to 20 %.

Also specify the following data:

- Part number and description (⇒ Section 9.1, Page 55)
- Quantity of spare parts
- Shipping address
- Mode of dispatch (freight, mail, express freight, air freight)

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

Table 16: Recommended spare parts stock for 2 years' operation to DIN 24296

Part No.	Description	Number of pumps ¹⁵⁾						
		2	3	4	5	6	8	10 or more
211	Pump shaft	1	1	2	2	2	3	30%
212	Intermediate shaft	1	1	2	2	2	3	30%
213	Top shaft	1	1	2	2	2	3	30%
230	Impeller	1	1	2	2	2	3	30%
321	Radial ball bearing	1	1	2	2	3	4	50%
330	Bearing bracket	-	-	-	-	-	1	2 pcs.
411.31	Spiral wound gasket	4	6	8	8	9	12	150%
423	Bearing guard	1	1	2	2	3	4	50%
433	Mechanical seal	1	1	1	2	2	2	20%
502	Casing wear ring	2	2	2	3	3	4	50%
503	Impeller wear ring	2	2	2	3	3	4	50%
524	Shaft protecting sleeve	1	1	1	2	2	2	20%
529	Bearing sleeve	1	1	2	2	3	4	50%
545	Bearing bush	1	1	2	2	3	4	50%
840	Coupling	1	1	2	2	2	3	30%
-	Gaskets and O-rings	4	6	8	8	9	12	150%

7.7.3 Interchangeability of pump components

Components featuring the same number in a column are interchangeable.



Table 17: Interchangeability of pump components

Size	Part No.																												Volute casing	Suction strainer	Casing cover	Pump shaft	Intermediate shaft	Top shaft	Impeller	Radial ball bearing	Bearing bracket lantern	Bearing housing	Bearing cover	Spiral wound gasket	Bearing guard	Bearing guard	Mechanical seal	Casing wear ring (suction side)	Casing wear ring (discharge side)	Impeller wear ring (suction side)	Impeller wear ring (discharge side)	Shaft protecting sleeve	Bearing sleeve	Bearing bush	Bearing bush	Intermediate coupling	Split muff coupling	Impeller nut	Key	Key
	102	143	161	211	212	213	230	321	344	350	360	411.31	423.1	423.2	433	502.1	502.2	503.1	503.2	524	529	545.1	545.2	848	851	922	940.1	940.5																												
25-180	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																												
25-230	2	1	2	1	1	1	2	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																												
40-180	3	2	1	1	1	1	3	1	1	1	1	1	1	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1																												

¹⁵ Including stand-by pumps

Size	Part No.																												
	102	143	161	211	212	213	230	321	344	350	360	411.31	423.1	423.2	433	502.1	502.2	503.1	503.2	524	529	545.1	545.2	848	851	922	940.1	940.5	
	Volute casing	Suction strainer	Casing cover	Pump shaft	Intermediate shaft	Top shaft	Impeller	Radial ball bearing	Bearing bracket lantern	Bearing housing	Bearing cover	Spiral wound gasket	Bearing guard	Bearing guard	Mechanical seal	Casing wear ring (suction side)	Casing wear ring (discharge side)	Impeller wear ring (suction side)	Impeller wear ring (discharge side)	Shaft protecting sleeve	Bearing sleeve	Bearing bush	Bearing bush	Intermediate coupling	Split muff coupling	Impeller nut	Key	Key	
40-230	4	2	2	1	1	1	4	1	1	1	1	2	1	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	
40-280	5	2	5	2	1	1	5	1	1	1	1	3	1	1	1	3	5	3	5	2	1	1	1	1	1	1	2	1	2
40-181	6	2	3	2	1	1	6	1	1	1	1	1	1	1	1	4	4	4	4	2	1	1	1	1	1	1	2	1	2
40-231	7	2	4	2	1	1	7	1	1	1	1	2	1	1	1	4	4	4	4	2	1	1	1	1	1	1	2	1	2
40-281	8	2	5	2	1	1	8	1	1	1	1	3	1	1	1	4	5	4	5	2	1	1	1	1	1	1	2	1	2
40-361	9	2	6	2	1	1	9	1	1	1	1	4	1	1	1	4	7	4	7	2	1	1	1	1	1	1	2	1	2
50-180	10	3	7	2	1	1	10	1	1	1	1	1	1	1	1	5	5	5	5	2	1	1	1	1	1	1	2	1	2
50-230	11	3	8	3	1	1	11	1	1	1	1	2	1	1	1	5	5	5	5	3	1	1	1	1	1	1	3	1	3
50-280	12	3	9	3	1	1	12	1	1	1	1	3	1	1	1	5	5	5	5	3	1	1	1	1	1	1	3	1	3
80-180	13	4	10	3	1	1	13	1	1	1	1	2	1	1	1	6	6	6	6	3	1	1	1	1	1	1	3	1	3
80-230	14	4	10	3	1	1	14	1	1	1	1	2	1	1	1	6	6	6	6	3	1	1	1	1	1	1	3	1	3
80-280	15	4	9	3	1	1	15	1	1	1	1	3	1	1	1	6	6	6	6	3	1	1	1	1	1	1	3	1	3

8 Trouble-shooting

	 WARNING
	Improper work to remedy faults Risk of injury! <p>► 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.</p>

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

- A** Pump delivers insufficient flow rate
- B** Motor is overloaded
- C** Excessive discharge pressure
- D** Increased bearing temperature
- E** Leakage at the pump
- F** Excessive leakage at the shaft seal
- G** Vibrations during pump operation
- H** Impermissible temperature increase in the pump

Table 18: Trouble-shooting

A	B	C	D	E	F	G	H	Possible cause	Remedy ¹⁶⁾
X	-	-	-	-	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point. Check system for impurities. Fit a larger impeller. ¹⁷⁾ Increase the speed (turbine, I.C. engine).
X	-	-	-	-	-	X	X	Pump and piping are not completely vented or primed.	Vent and prime.
X	-	-	-	-	-	-	-	Supply line or impeller clogged	Remove deposits in the pump and/or piping.
X	-	-	-	-	-	-	-	Formation of air pockets in the piping	Alter piping layout. Fit vent valve.
X	-	-	-	-	-	X	X	Suction lift is too high/NPSH _{available} (positive suction head) is too low.	Check/alter fluid level. Install pump at a lower level. Fully open the shut-off element in the suction line. Change suction line, if the friction losses in the suction line are too high. Check any strainers installed/suction opening. Observe permissible speed of pressure fall.
X	-	-	-	-	-	-	-	Air intake at the shaft seal	Clean barrier fluid duct, supply external barrier fluid if necessary, or increase barrier fluid pressure. Replace shaft seal.
X	-	-	-	-	-	-	-	Wrong direction of rotation	Check the electrical connection of the motor and the control system, if any.
X	-	-	-	-	-	-	-	<ul style="list-style-type: none"> ▪ Speed is too low. ¹⁷⁾ ▪ Operation with frequency inverter ▪ Operation without frequency inverter 	<ul style="list-style-type: none"> ▪ Increase voltage/frequency at the frequency inverter in the permissible range. Check voltage.
X	-	-	-	-	-	X	-	Impeller	Replace worn components by new ones.

¹⁶⁾ Pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.

¹⁷⁾ Contact KSB.

A	B	C	D	E	F	G	H	Possible cause	Remedy ¹⁶⁾
-	X	-	-	-	-	X	-	Pump back pressure is lower than specified in the purchase order.	Re-adjust to duty point. In the case of persistent overloading, turn down impeller. ¹⁷⁾
-	X	-	-	-	-	-	-	Density or viscosity of fluid handled higher than stated in purchase order	Contact KSB.
-	X	X	-	-	-	-	-	Speed is too high.	Reduce speed. ¹⁷⁾
-	-	-	-	X	-	-	-	Defective gasket	Fit new gasket between volute casing and discharge cover.
-	-	-	-	-	X	-	-	Worn shaft seals	Fit new shaft seal. Check flushing liquid/barrier fluid.
-	-	-	-	-	X	-	-	Vibrations during pump operation	Correct the suction conditions. Re-align the pump. Re-balance the impeller. Increase pressure at the pump suction nozzle.
-	-	-	X	-	X	X	-	The pump set is misaligned.	Re-align.
-	-	-	X	-	X	X	-	Pump is warped or sympathetic vibrations in the piping.	Check the piping connections and secure fixing of pump; if required, reduce distances between the pipe clamps. Fix the pipelines using anti-vibration material.
-	-	-	X	-	-	X	-	Insufficient or excessive quantity of lubricant or unsuitable lubricant	Top up, reduce and/or change lubricant.
-	-	-	X	-	-	-	-	Non-compliance with specified coupling distance	Correct the distance according to the general arrangement drawing.
X	X	-	-	-	-	-	-	Motor is running on 2 phases only.	Replace the defective fuse. Check the electric cable connections.
-	-	-	-	-	-	X	-	Rotor out of balance	Clean the impeller. Re-balance the impeller.
-	-	-	-	-	-	X	-	Defective bearing(s)	Replace.
-	-	-	-	-	-	X	X	Flow rate too low	Increase the minimum flow rate.
-	-	-	-	-	X	-	-	Incorrect inflow of circulation liquid	Increase the free cross-section.

9 Related Documents

9.1 General assembly drawings with list of components

9.1.1 General assembly drawing, discharge side

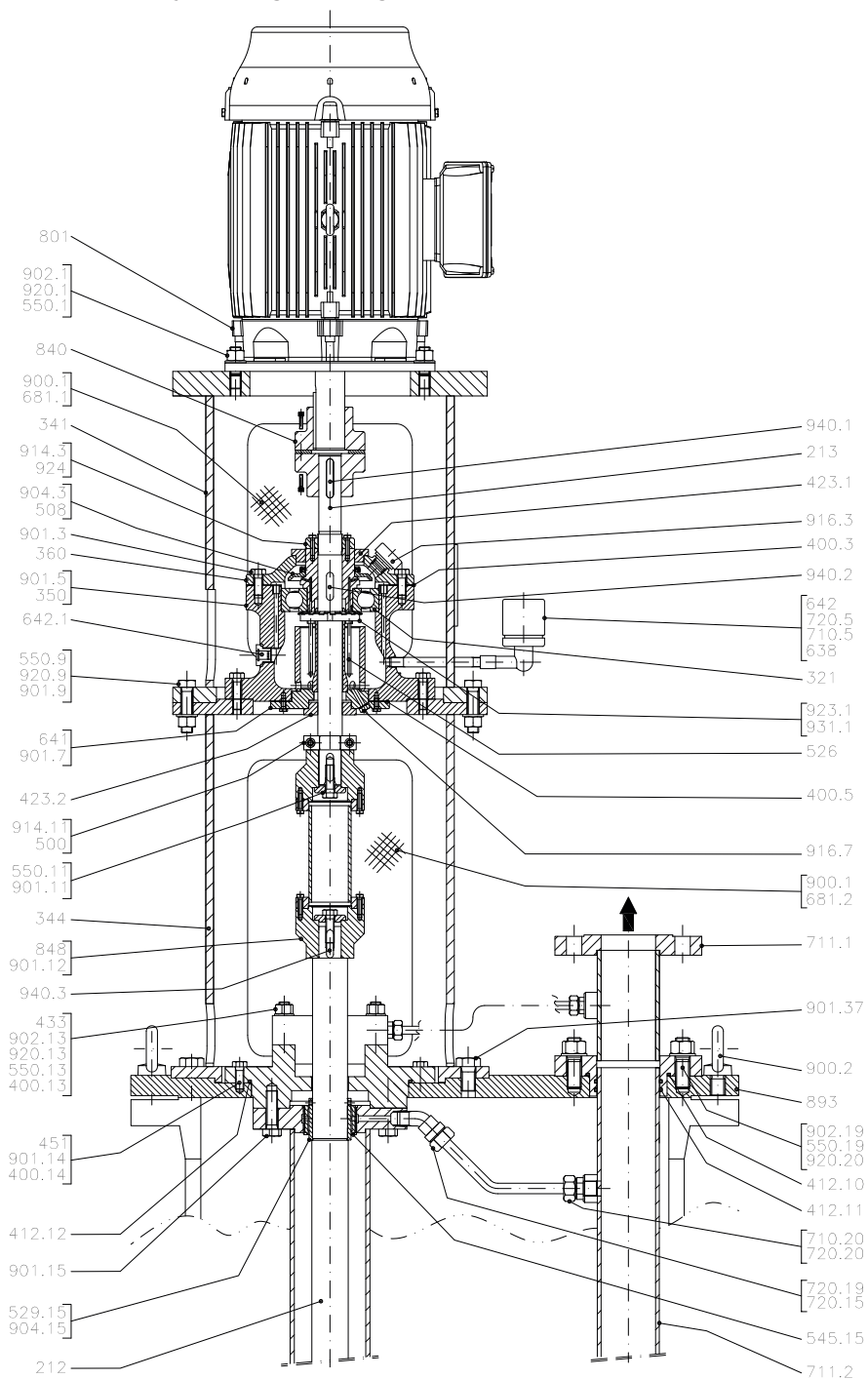


Fig. 11: General assembly drawing, discharge side

9.1.2 General assembly drawing, suction side

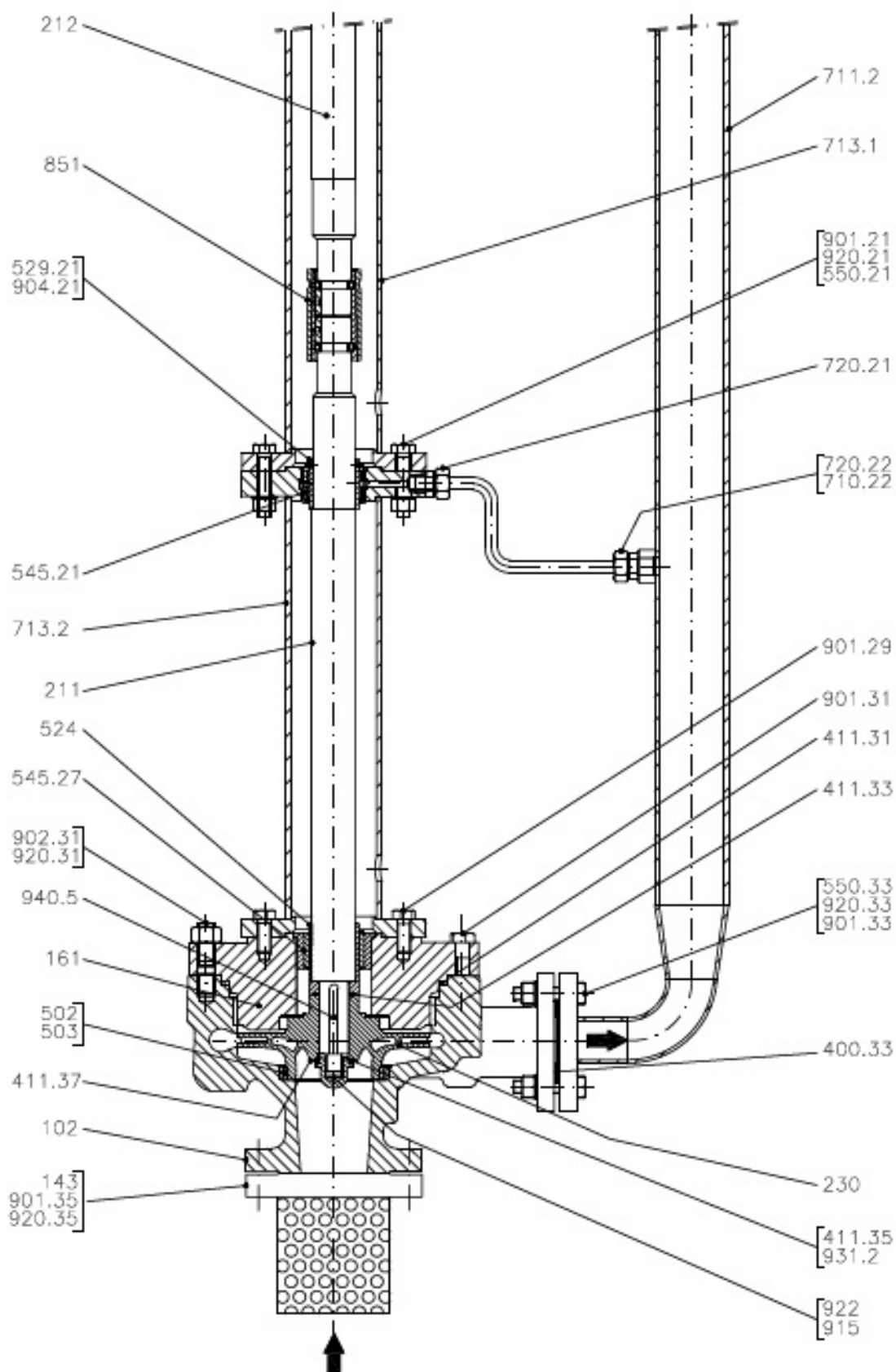


Fig. 12: General assembly drawing, suction side

Table 19: List of components

Part No.	Description	Part No.	Description
102	Volute casing	638	Constant level oiler
143	Suction strainer	641	Oil level tube
161	Casing cover	642	Oil level sight glass
211	Pump shaft	681.1/.2	Coupling guard
212	Intermediate shaft	710.5/.20/.22	Pipe
213	Top shaft	711.1/.2	Riser
230	Impeller	713.1/.2	Suspension pipe
321	Radial ball bearing	720.5/.15/.19/.20/.21/.22	Fitting
341	Drive lantern	801	Flanged motor
344	Bearing bracket lantern	840	Coupling
350	Bearing housing	848	Intermediate coupling
360	Bearing cover	851	Conical coupling
400.3/.5/.13/.14/.17/33	Gasket	893	Soleplate
411.31/.33/.35/.37	Spiral wound gasket	900.1/.2	Bolt/screw
412.10.11	O-ring	901.3/.5/.7/.9/.11/.12/.14/.15/.21/.29/.31/.33/.35/.37	Hexagon head bolt
423.1/.2	Labyrinth ring	902.1/.13/.19/.31	Stud
433	Mechanical seal	904.3/.15/.21	Grub screw
451	Stuffing box housing	914.3/.11	Hexagon socket head cap screw
500	Ring	915	Threaded insert
502	Casing wear ring	916.3/.7/.15	Plug
503	Impeller wear ring	920.1/.9/.13/.20/.21/.31/.33/.35	Nut
508	Oil thrower	922	Impeller nut
524	Shaft protecting sleeve	923.1	Bearing nut
526	Centring sleeve	924	Adjusting nut
529.15/.21	Bearing sleeve	931.1/.2	Lock washer
545.15/.21/.27	Bearing bush	940.1/.2/.3/.4/.5	Key
550.1/.9/.11/.13/.19/.21/.33	Disc		

9.1.3 Detailed view of the bearing housing

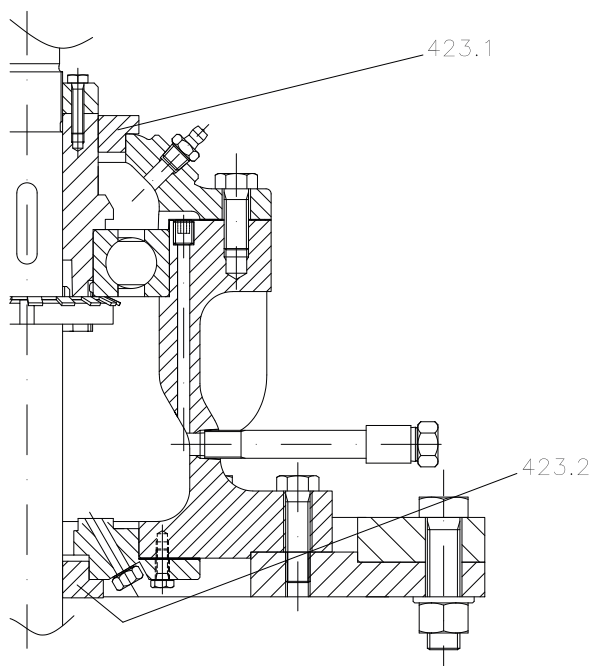


Fig. 13: Detailed view: bearing housing with grease-lubricated bearing and throwers / labyrinth rings

Table 20: List of components

Part No.	Description
423.1/.2	Bearing guard

10 EU Declaration of Conformity

Manufacturer:

KSB Bombas Hidráulicas S.A
Rua José Rabello Portella, 638
CEP: 13.220-540 - Jardim Maria de Fátima
Várzea Paulista (Brazil)

The manufacturer herewith declares that the product:

RPH-V

KSB order number:

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

The manufacturer also declares that

- the following harmonised international standards¹⁸⁾ have been applied:
 - ISO 12100
 - EN 809

Person authorised to compile the technical file:

Dr. Norbert Kastrup
 Head of Product Development
 Corporate Unit Pumps
 KSB SE & Co. KGaA
 Bahnhofplatz 1
 91257 Pegnitz (Germany)

The EU Declaration of Conformity was issued in/on:

Place, date

.....¹⁹⁾.....

Name
 Function
 Company
 Address

¹⁸ 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.

¹⁹ A signed, legally binding EU Declaration of Conformity is supplied with the product.

11 Certificate of Decontamination

Type:

Order number/

Order item number²⁰⁾:

Delivery date:

Applications:

Fluid handled²⁰⁾:

Please tick where applicable²⁰⁾:



Corrosive



Oxidising



Flammable



Explosive



Hazardous to health



Seriously hazardous to health



Toxic



Radioactive



Bio-hazardous



Safe

Reason for return²⁰⁾:

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, 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

²⁰⁾ Required fields

Index

A

Abrasive fluids 37
Applications 9
Auxiliary connections 26

B

Bearing temperature 41
Bearings 17

C

Certificate of Decontamination 60
Clearances 42
Commissioning 30
Constant level oiler 30
Contact guard 20
Coupling 20, 42

D

Design 16, 18
Designation 16
Direction of rotation 17, 29
Dismantling 45
Disposal 15
Distance to the tank floor 23
Drive 17

E

Event of damage 6
 Ordering spare parts 50
Explosion protection 10, 21, 26, 27, 28, 29, 32, 33, 34, 35, 36, 39, 40, 41, 43

F

Faults
 Causes and remedies 53
Final check 32
Flow rate 36
Fluid handled
 Density 37
Frequency of starts 36
Function 18

I

Impeller type 17
Installation at site 21
Intended use 9
Interchangeability of pump components 51

K

Key to safety symbols/markings 8

M

Maintenance 40
Mechanical seal 34
Monitoring equipment 11

N

Name plate 16
Noise characteristics 19

O

Oil lubrication
 Intervals 43
 Oil quality 43
Operating limits 35
Order number 6
Other applicable documents 6

P

Partly completed machinery 6
Preservation 14, 38
Priming and venting 32
Product description 16
Pump casing 17

R

Return to supplier 14
Returning to service 38
Running noises 40, 41

S

Safety 8
Safety awareness 9
Scope of supply 19
Shaft guide bearings 17
Shaft seal 17
Shutdown 35, 38
Soleplate 20
Spare part
 Ordering spare parts 50
Start-up 34
Storage 14, 38

T

Temperature limits 11
Transport 13

W

Warnings 8
Warranty claims 6
Water cooling 33



KSB Bombas Hidráulicas S/A

Rua José Rabello Portella, 638

CEP: 13.220-540 - Jardim Maria de Fátima

Várzea Paulista (Brasil)

Tel.: +55 11 4596 8500 • Fax Fax: +55 11 4596 8580

www.ksb.com