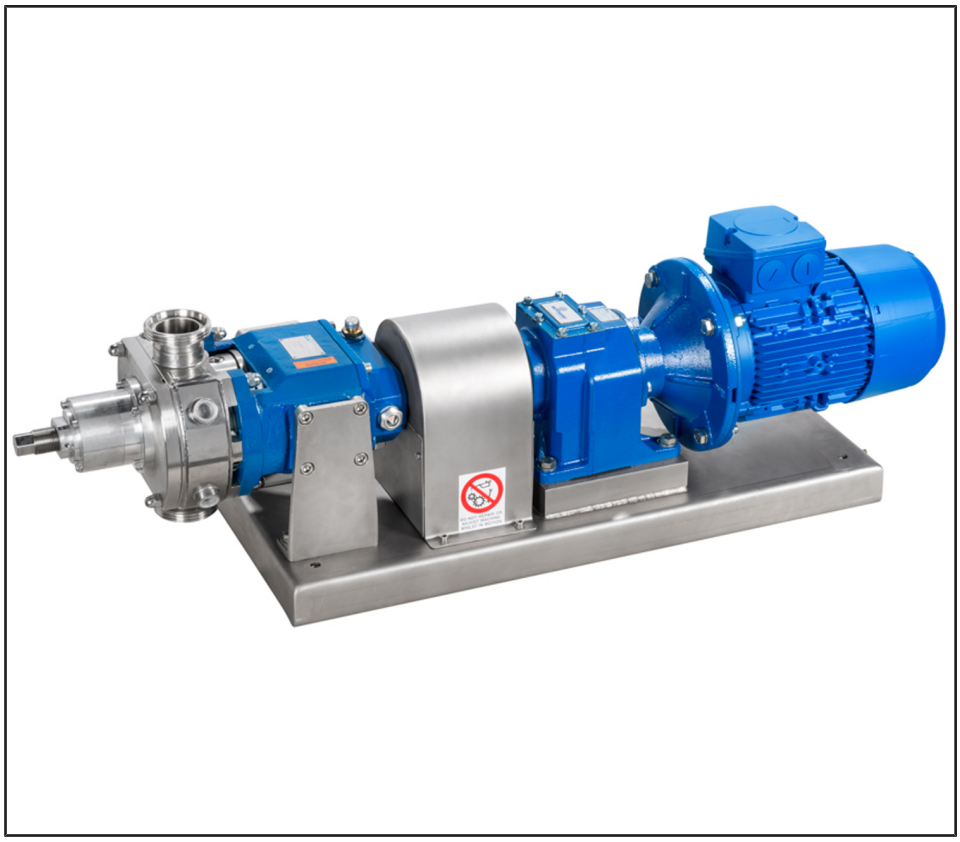
Hygienic Pump

Vitalobe

Installation/Operating Manual



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Installation/Operating Manual Vitalobe

Original operating manual

Contents

Glossary

Certificate of decontamination

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

CIP (cleaning in place)

Procedure during which the inside of the pump is cleaned with a cleaning agent. The pump does not need to be dismantled.

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

In-line design

A pump whose suction and discharge nozzle are arranged opposite each other and have the same nominal diameter.

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

SIP (steaming in place)

Procedure during which the inside of the pump is sterilised with steam. The pump does not need to be dismantled.

Suction lift line/suction head line

The pipeline which is connected to the suction nozzle

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1 General

1.1 Principles

This operating manual is supplied as an integral part of 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 centre 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 instruction manual is aimed at the target group of trained and qualified specialist technical personnel. (⇨ Section 2.3, 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)
General arrangement drawing/ outline drawing	Description of mating and installation dimensions for the pump (set), weights
Hydraulic characteristic curve	Characteristic curves showing head, $NPSH_{required}$, efficiency and power input
General assembly drawing[1)]	Sectional drawing of the pump
Sub-supplier product literature[1)]	Operating manuals and other product literature describing accessories and integrated machinery components
Spare parts lists[1)]	Description of spare parts
Piping layout[1)]	Description of auxiliary piping
List of components[1)]	Description of all pump components

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

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1 If agreed to be included in the scope of supply

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

1.6 Key to safety symbols/markings

Table 3: Definition of safety symbols/markings

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

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2 Safety

DANGER

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

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

2.1 General

This instruction 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.

The safety information in all sections of this manual must be complied with.

The instruction manual must be read and understood by the responsible specialist personnel/operators prior to installation and commissioning.

The contents of this instruction manual must be available to the specialist personnel at the site at all times.

Information 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 in this instruction manual.

2.2 Intended use

- The pump (set) must only be operated in the fields of application and within the use limits specified in the other applicable documents.
- 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 to handle the fluids described in the data sheet or product literature of the pump model or variant.
- Never operate the pump without the fluid to be handled.
- Observe the minimum flow rates indicated in the data sheet or product literature (to prevent overheating, bearing damage, etc).
- 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.).
- Do not throttle the flow rate on the suction side of the pump (to prevent cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.

2.3 Personnel qualification and training

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

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

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

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

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

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

2.5 Safety awareness

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

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

2.6 Safety information for the operator/user

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

2.7 Safety information for maintenance, inspection and installation

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

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- When taking the pump set out of service always adhere to the procedure described in the manual. (⇨ Section 6.3, Page 47)
- 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 40)

2.8 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 2.2, Page 9)

2.9 Explosion protection

DANGER

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 Ex symbol and the following sections, (⇨ Section 2.9.1, Page 11) to
The explosion-proof status is only assured if the product is used in accordance with its intended use.
Never operate the product outside the limits stated in the data sheet and on the name plate.
Prevent impermissible modes of operation at all times.

2.9.1 Marking

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

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

Refer to the Temperature limits table for the maximum temperatures permitted for the individual pump variants.

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.

2.9.2 Temperature limits

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

The table (⇨ Table 4) lists the temperature classes and the resulting maximum permissible fluid temperatures. The values shown correspond to the theoretical limits. They include only a general safety margin for the mechanical seal. For single mechanical seals, the safety margin required for specific operating conditions and mechanical seal designs may be substantially higher. If operating conditions differ from those stated on the data sheet, or if different mechanical seals are used, the actual safety margin required needs to be determined individually. If in doubt please contact the manufacturer.

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

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

Table 4: Temperature limits

Temperature class to EN 13463-1 or ISO 80079-36	Maximum permissible fluid temperature[2)]
T1	Temperature limit of the pump
T2	Temperature limit of the pump
T3	150 °C
T4	105 °C

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.

Motor supplied by the operator

If a pump is supplied without motor (as part of a pool of pumps), the motor specified in the pump data sheet must meet the following conditions:

- The permissible temperature limits at the motor flange and motor shaft must be higher than the temperatures generated by the pump.
- Contact the manufacturer for the actual pump temperatures.

2.9.3 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.

In a potentially explosive atmosphere the pump sets must be equipped with a pressure relief valve. If the pump has not been fitted by the manufacturer with a pressure relief valve, the operator must fit the pump with a pressure relief valve (e.g. bypass valve) on site.

Contact KSB for further information on monitoring equipment.

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2 Subject to further limitations for mechanical seal temperature rise

3 Transport/Temporary Storage/Disposal

3.1 Checking the condition upon delivery

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

3.2 Transport

DANGER

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

Danger to life from falling parts!

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

To transport the pump/pump set suspend it from the lifting tackle as shown.

The motor shroud, if fitted, must be removed before transporting the pump set.

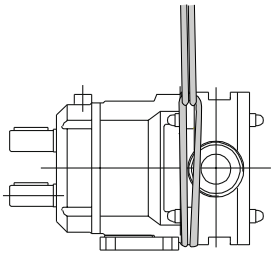

Fig. 1: Transporting the pump

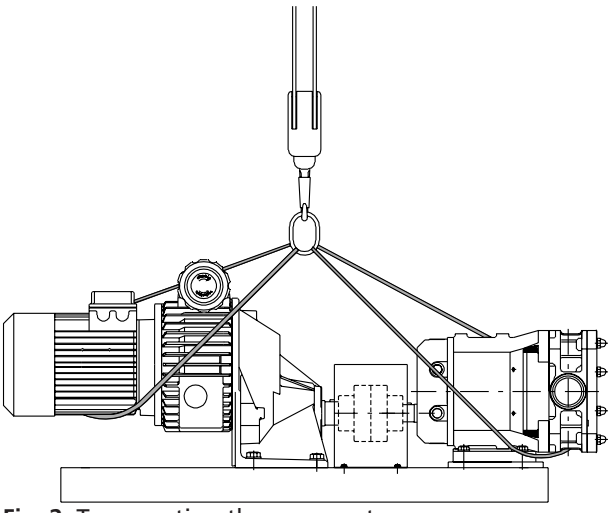

Fig. 2: Transporting the pump set

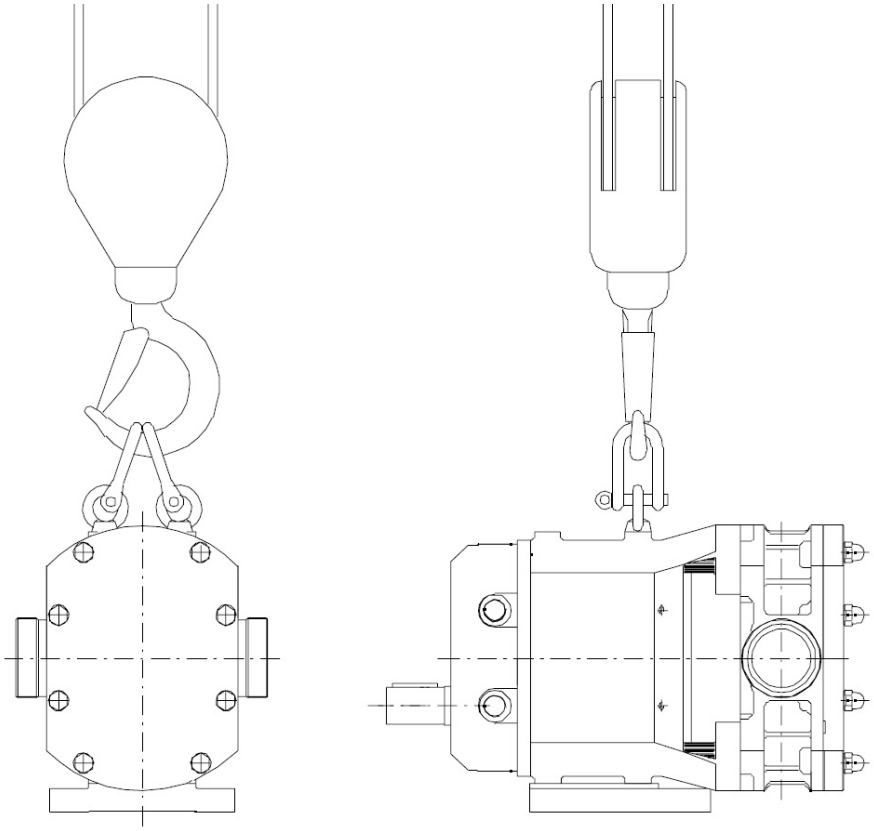

Fig. 3: Lifting the pump

3.3 Storage/preservation

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

	**CAUTION** **Damage during storage due to humidity, dirt or vermin** Corrosion/contamination of the pump (set)! ▷ For outdoor storage cover the pump (set) or the packaged pump (set) and accessories with waterproof material.

	**CAUTION** **Wet, contaminated or damaged openings and connections** Leakage or damage to the pump! ▷ Clean and cover pump openings and connections as required prior to putting the pump into storage.

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 12 months. New pumps/pump sets are supplied by our factory duly prepared for storage. For storage periods of longer than 60 days protect the coupling surfaces with a suitable preservative.

For storing a pump (set) which has already been operated, observe the instructions in (⇨ Section 6.3.1, Page 47) .

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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 115)

NOTE

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

3.5 Disposal

⚠ WARNING

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

Hazard to persons and the environment!

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

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

4 Description of the Pump (Set)

4.1 General description

- Hygienic pump

Pump for handling fluids which are neither chemically aggressive nor abrasive and which do not require hermetic sealing.

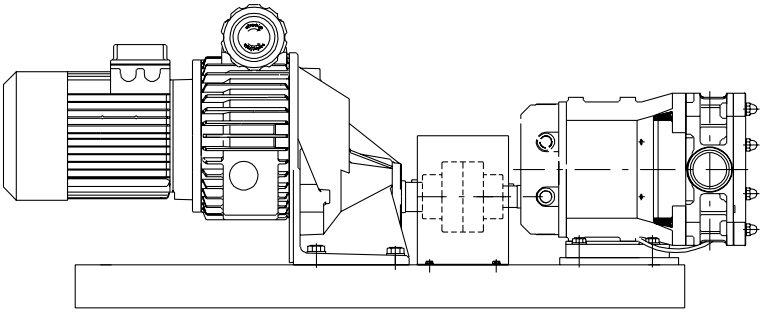

Fig. 4: Installing the pump set

Pump in long-coupled design with coupling and geared motor with/without frequency inverter. Horizontal or vertical connection nozzles. Drive ratings from 1 to 90 kW.

Shaft seal

Designs:

- G: External, single mechanical seal without flushing system
- VG: External, single mechanical seal with flushing system
- L: Shaft seal ring
- Q: Double mechanical seal in back-to-back arrangement

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

For information as per chemicals Regulation (EC) No. 1907/2006 (REACH), see https://www.ksb.com/ksb-en/About-KSB/Corporate-responsibility/reach/ .

4.3 Designation

Table 5: Designation example

Position																										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
V	L	B		1	0	0	/	0	4	0	2	G	D	B	Y	3	1	A	E	C	C	S	P	P	H	S	A
See name plate and data sheet																											

Table 6: Designation key

Position	Code	Description	
1-4	Pump type		
	VLB	Vitalobe B	
	VLBB	Vitalobe BB	
5-8	Size, e.g.		
	100/	Rotor diameter [mm]	
	...	...	
	550/	Rotor diameter [mm]	Vitalobe B
	660/	Rotor diameter [mm]	Vitalobe B
	680/	Rotor diameter [mm]	Vitalobe B
9-11	Motor rating P_N [kW]		
	007	0,70	
	...	...	

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Position	Code	Description	
9-11	550	55,00	
12	Number of motor poles		
13	Scope of supply		
	G	Baseplate	
	V	Trolley	
14-15	Shaft seal type		
	DB	Double mechanical seal, external, in back-to-back arrangement	
	J	Single mechanical seal, external	
	JY	Single mechanical seal, external flushing system (quench)	
	L	Lip seal	
16-18	Seal code, single mechanical seal		
	Y31	BGEFG	
	Y32	BGVFG	
	Y34	BGMFG	
	Y41	BU3EFG	
	Y42	BU3VFG	
	Y44	BU3MFG	
	Y51	U3U3EFG	
	Y52	U3U3VFG	
	Y54	U3U3MFG	
	Seal code, double mechanical seal in back-to-back arrangement		
	Q31	GBEFG	Vitalobe B
		GBEFG	Vitalobe B
	Q32	GBVFG	Vitalobe B
		GBVFG	Vitalobe B
	Q34	GBMFG	Vitalobe B
		GBMFG	Vitalobe B
	Q41	U3BEFG	Vitalobe B
		U3BEFG	Vitalobe B
	Q42	U3BVFG	Vitalobe B
		U3BVFG	Vitalobe B
	Q44	U3BMFG	Vitalobe B
		U3BMFG	Vitalobe B
	Q51	U3U3EFG	Vitalobe B
		U3U3EFG	Vitalobe B
	Q52	U3U3VFG	Vitalobe B
		U3U3VFG	Vitalobe B
	Q54	U3U3MFG	Vitalobe B
		U3U3MFG	Vitalobe B
	Seal code, lip seal		
	HN	S.S./PTFE	Vitalobe B / Vitalobe BB
	S1	H-ECOPUR FDA	Vitalobe B
	S16	H-ECOPUR FDA	Vitalobe BB
	UM	FKM	Vitalobe B
19	Pipe connection		
	A	Flange	APV
	B	Thread	DIN 11864-1A
	C	Flange	DIN 11864-2A
	D	Clamped connection	DIN 11864-3A

Position	Code	Description	
19	E	Thread	DIN 11853
	F	Thread	RJT
	G	Flange	Varivent
	I	Thread	ISO 2853 (IDF)
	L	Flange	EN 1092-1
	M	Thread	DIN 11851 (hygienic pipe union)
	S	Thread	SMS
	T	Clamped connection	DIN 32676-A
	U	Clamped connection	DIN 32676-C (Tri-Clamp)
	V	Clamped connection	ISO 2852
	Z	Flange	ANSI B16.5 Class 150
20	O-ring material (casing/impeller)		
	E	EPDM	
	F	FFKM (Kaflon)	
	K	FFKM (Kalrez)	
	M	FEP (encapsulated)	
	T	PTFE (Viton core)	
	V	FKM	
21	Pump casing material		
	C	Stainless steel	1.4409
	D	Super duplex stainless steel	1.4469 / 1.4410
	M	Monel 400	2.4360
	T	Titanium	B348 GR5
	X	Hastelloy C276	2.4819
22	Rotor material		
	C	Stainless steel	1.4409
	D	Super duplex stainless steel	1.4469 / 1.4410
	E	EPDM-coated (core 1.4404)	-
	F	Stainless steel sliding alloy	ASTM A494 CY5SNBIM
	M	Monel 400	2.4360
	N	NBR	-
	T	Titanium	B348 GR5
	X	Hastelloy C276	2.4819
23	Motor shroud		
	S	With shroud	
	O	Without shroud	
24	Drain		
	P	Casing drain via piping	
	V	Casing drain via valve	
	D	Casing drain with plug	
	O	No drain	
25	Safety valve		
	B	By-pass	
	O	Without safety valve	
	P	Pneumatic safety valve	
	V	Mechanical safety valve	
26	Position of nozzles		
	H	Horizontal	
	V	Vertical	

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Position	Code	Description
27	Design	
	S	Standard
	X	Non-standard (BT3D, BT3)
28	Product generation	
	A	Vitalobe

4.4 Name plate

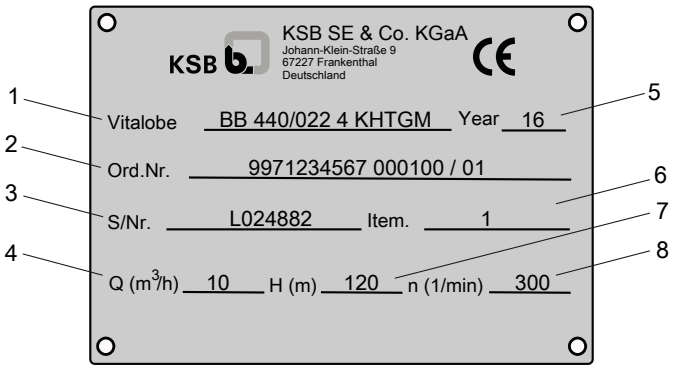

Fig. 5: Name plate (example)

1	Pump type, type series, size, version	2	KSB order number
3	Serial No.	4	Flow rate
5	Year of construction	6	Item number
7	Head	8	Speed

4.5 Design details

Design

- Standard design with materials to Regulation (EC) No. 1935/2004[3)]
- Design to ATEX

Design

- Hygienic rotary lobe pump
- Long-coupled design
- In-line design
- Wetted parts made of stainless steel 1.4404/1.4409 (AISI 316L/CF3M)
- Cleanability levels 1 + 2 to EN 13951 for Vitalobe design B
- Cleanability levels 3 + 4 to EN 13951 for Vitalobe design BB

Pump casing

- Rotor casing

Impeller type

- Tri-lobe, bi-lobe, gear-shaped or bi-wing rotor

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3 Only for Vitalobe design BB

Bearings

- Size 100: deep groove ball bearing and needle bearing
- Sizes 105 to 115: tapered roller bearings
- Sizes 215 to 490: double tapered roller bearings
- Sizes 550 to 680: cylindrical roller bearing and two-row deep groove ball bearings

Shaft seal

- Single mechanical seals with or without flushing system to EN 12756
- Double mechanical seals to EN 12756

Different seal types

- Seal type Y: external single mechanical seal, with or without flushing system
- Seal type Q: external double mechanical seal in back-to-back arrangement
- Seal type L: shaft seal ring, single or double

Clearance

- The rotors rotate in the casing without touching each other.

The clearances depend on the application.

- Standard clearance for minimum leakage flow and best hydraulic efficiency
- Enlarged clearance for high pressures or high temperatures

Drive

Speed and torque of the motor are adjusted to the values required for the pump by means of a gear unit.

- Surface-cooled KSB squirrel-cage motor
- Type of construction B5, V1
- Thermal class F
- 3 PTC thermistors
- Duty type: continuous duty S1
- Winding 50 Hz, 220 - 240 V / 380 - 420 V ≤ 2.20 kW; 380 - 420 V / 660 - 725 V ≥ 3.00 kW

Connections

- Axial suction nozzle, tangential discharge nozzle
- Adjustable through 360°

Types of connection:

- Threaded connection to DIN 11851 (hygienic pipe union)
- Threaded connection to DIN 11853
- Threaded connection to DIN 11864-1-GS-A
- Threaded connection to SMS standard
- Threaded connection to ISO 2853 (IDF)
- Threaded connection to RJT standard
- Clamped connection to DIN 32676-C (Tri-Clamp/Tri-Clover fitting)
- Clamped connection to DIN 11864-3-NKS-A
- Clamped connection to DIN 32676-A
- Clamped connection to ISO 2852
- Flange to EN 1092-1
- Flange to DIN 11864-2-NF-A
- Flange to ANSI B16.5 Class 150

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- APV flange
- Varivent flange
- Other connection types on request

4.6 Configuration and function

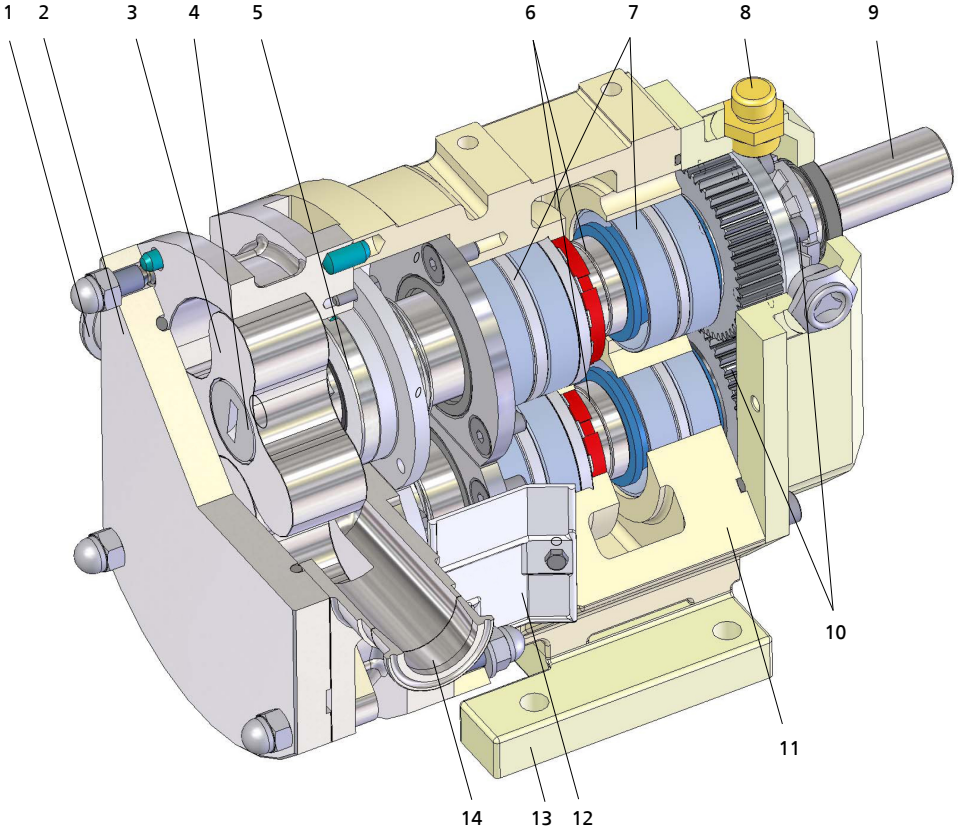

Fig. 6: Sectional drawing

1	Suction nozzle	2	Pump casing / cover
3	Impeller (tri-lobe)	4	Impeller screw
5	Mechanical seal	6	Drive shafts
7	Bearings	8	Oil filler plug
9	Driving shaft	10	Spur gearing
11	Bearing bracket	12	Cover plate
13	Foot	14	Discharge nozzle

Design The pump is designed with a radial fluid inlet and outlet in either horizontal or vertical position. The hydraulic system is connected to the motor by a shaft coupling. Normally, frequency inverter controlled geared motors are used. The pump and the motor are mounted on a common baseplate.

Design standard The Vitalobe pump series is available in two design standards, which only differ in the pump head design. The bearing bracket and gears are identical.

Design standard B: available for sizes 100-680; non-countersunk rotor screws, confined O-rings

Design standard BB: available for sizes 100-490; counter-sunk rotor screws, flush mounted O-rings

Function The fluid is pumped by two counter-rotating impellers (3) with intermeshing rotary lobes inside the pump casing (2). Each impeller (3) is mounted on a shaft (6) by means of a screw (4). The shafts run in bearings located in the bearing housing (11). Shaft rotation is synchronised via spur gears (10), which transfer the torque of the driving shaft (9) to the driven shaft. The impellers (3) inside the casing (2) are synchronised such that they do not contact each other. As soon as the impeller lobes disengage, the increasing volume between the lobes creates a vacuum on the suction side,

drawing the fluid through the suction nozzle (1) into the pump casing. The fluid is trapped in the space between the impellers (between the lobes) and transported through the rotor casing to the pump's discharge nozzle (14). As soon as the impellers re-engage, the volume between them decreases, the pressure at the discharge (14) increases, and the fluid is forced out of the pump casing. The pump set is bi-directional, i.e. capable of providing full pump performance in either direction of rotation of the impellers. The flow rate is adjusted by increasing or decreasing the motor speed, and thus the impeller revolutions.

Sealing The pump is sealed either by a mechanical seal (5), a shaft seal ring or a gland packing, depending on the application conditions.

Various seal designs can be used. (⇨ Section 4.1, Page 16)

4.7 Noise characteristics

Sound pressure level < 65 dB(A)

4.8 Overview of pump sizes: discharge pressure

Table 7: Table of discharge pressure

Size	Maximum speed [rpm]	Maximum discharge pressure [bar]				Impeller type - volume displaced [l/revolution]			Standard connection size
		ST version		SM version					
		1.4404 (316L)	Duplex stainless steel (1.44062)	1.4404 (316L)	Duplex stainless steel (1.44062)	Bi-lobe	Tri-lobe	Bi-wing	
100	1400	7	10	-	-	0,035	0,035	-	DN25
105	1000	10	13	15	18	-	0,075	0,07	DN 40
110	1000	10	13	15	18	0,138	0,138	0,124	DN 40
115	1000	7	10	12	15	0,2	0,204	0,19	DN 40
215	950	10	13	15	18	0,274	0,274	0,244	DN 40
220	950	7	10	12	15	0,39	0,39	0,34	DN 50
325	720	10	13	15	18	0,62	0,62	0,55	DN 65
330	720	7	10	12	15	0,79	0,79	0,7	DN 80
390	720	5	7	10	12	1,0	1,0	0,9	DN 80
430	600	10	13	15	18	1,3	1,31	1,17	DN 80
440	600	7	10	12	15	1,74	1,75	1,56	DN 100
470	500	10	13	15	18	2,36	2,38	2,1	DN 100
490	500	7	10	12	15	3,24	3,27	2,88	DN 100
550	500	5	-	7	-	4,0	4,0	3,8	DN 125
660	500	7	-	-	-	-	7,6	-	DN 150
680	500	5	-	-	-	-	11,4	-	DN 200

4.9 Scope of supply

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

- Pump
- Drive
- Frequency inverter
- Trolley with switch and power cable
- Protective cover
- Baseplate or foot base

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4.10 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

Improper installation in potentially explosive atmospheres

Explosion hazard!

Damage to the pump set!

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

WARNING

Improper installation of the pump set

Personal injury and damage to property!

- ▹ Adhere to the instructions for installing the pump set described below in order to prevent major hazards and injuries.

5.2 Checks to be carried out prior to installation

Place of installation

WARNING

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

Personal injury and damage to property!

- ▹ Use a concrete of compressive strength class C12/15 which meets the requirements of exposure class XC1 to EN 206-1.
- ▹ The mounting surface must be set, flat, and level.
- ▹ Observe the weights indicated.

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

CAUTION

Improper installation of the pump set

Damage to property!

- ▹ The pump set must be installed in an enclosed room and protected from adverse environmental conditions.

NOTE

The pump set is most efficiently operated at temperatures of between +5 °C and +40 °C and with an atmospheric humidity of under 50 %.

CAUTION

Use of the pump in adverse ambient conditions

Damage to property!

- ▹ Never operate the pump set in ambient conditions other than those described.

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5.3 Installing the pump set

Always install the pump set in a horizontal position.

DANGER

Static charging due to insufficient potential equalisation

Explosion hazard!

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

DANGER

Excessive temperatures due to improper installation

Explosion hazard!

- ▷ Install the pump in a horizontal position to ensure self-venting of the pump.

NOTE

When installing the system, ensure that sufficient space is available around the pump set to facilitate servicing and maintenance.

5.3.1 Installation on a foundation

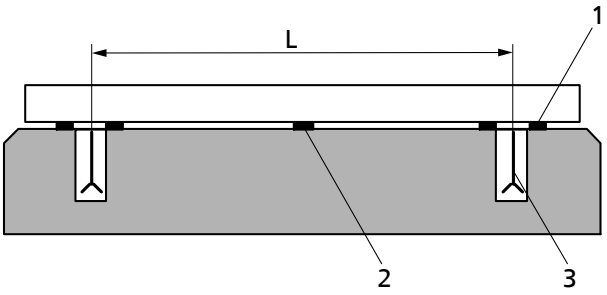

Fig. 7: Fitting the shims

L	Bolt-to-bolt distance	1	Shim
2	Shim if L > 800 mm	3	Foundation bolt

✓ The foundation has the required strength and characteristics.

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

1. Position the pump set on the foundation and level it with the help of a spirit level placed on the shaft and discharge nozzle.
   Permissible deviation 0.2 mm/m.
2. Use shims (1) for height compensation, if necessary.
   Always fit shims, if any, immediately to the left and right of the foundation bolts (3) between the baseplate/foundation and the foundation.
   For a bolt-to-bolt distance (L) > 800 mm fit additional shims (2) halfway between the bolt holes.
   All shims must lie perfectly flush.
3. Insert the foundation bolts (3) into the holes provided.
4. Use concrete to set the foundation bolts (3) into the foundation.
5. Wait until the concrete has set firmly, then level the baseplate.
6. Tighten the foundation bolts (3) evenly and firmly.
7. Grout the baseplate using low-shrinkage concrete with a standard particle size and a water/cement ratio of ≤ 0.5.
   Produce flowability with the help of a solvent.
   Cure the concrete to DIN 1045.

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NOTE

For low-noise operation the pump set can be mounted on vibration dampers upon confirmation by the manufacturer. In this case, only fasten the flexible elements at the baseplate after the piping has been connected.

NOTE

Expansion joints can be fitted between the pump and the suction line or discharge line. They do not serve, however, to compensate inaccurate installation or flange offsets, but to absorb changes in fluid volume caused by temperature changes, reduce mechanical stresses from surge pressures and dampen noise caused by vibrations. Expansion joints should have 1 to 1.5 times the nominal pipe diameter. For higher viscosity fluids, larger expansion joints should be selected.

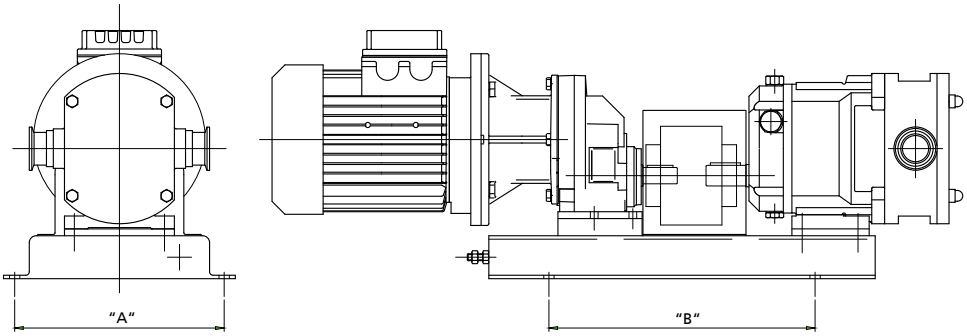

Fig. 8: Installation on a foundation

Table 8: Foundation bolt size

Baseplate size	A	B	Foundation bolt size
0	244	310	M10
1	244	310	M10
2	314	460	M10
3	350	660	M16
4	470	800	M16
7	200	340	M8
8	566	1000	M20

NOTE

The drilled holes provided in the baseplate can be used for mounting the pump set on a base.

5.3.2 Installation on machine mounts

CAUTION

Improper installation of the pump set

Damage to property!

- ▷ Use rubber-coated machine mounts to prevent the pump set from slipping.

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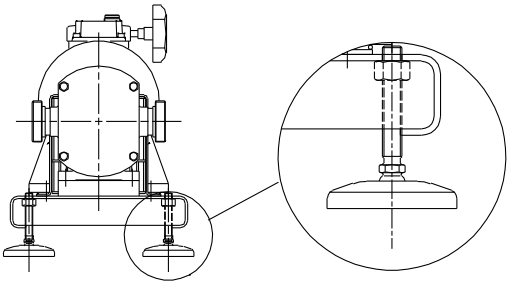

Fig. 9: Installation on machine mounts

✓ The installation surface is level and has the required strength and characteristics.

1. Position the pump set and level it with the help of a spirit level placed on the suction/discharge nozzle. The feet are vertically adjustable and must rest evenly on the installation surface.

5.4 Piping

CAUTION

Contamination/dirt in the piping

Damage to the pump!

- ▹ Clean the piping and check for contamination before connecting to the pump.

NOTE

Whenever modifications to the system (e.g. installation of fittings) are performed, always clean the piping avoiding that dirt can enter the pump.

5.4.1 Connecting the piping

DANGER

Impermissible loads acting on the pump nozzles

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

- ▹ Do not use the pump as an anchorage point for the piping.
- ▹ Anchor the pipes in close proximity to the pump and connect them properly without transmitting any stresses or strains.
- ▹ Take appropriate measures to compensate for thermal expansion of the piping.

CAUTION

Incorrect earthing during welding work at the piping

Destruction of rolling element bearings (pitting effect)!

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

NOTE

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

✓ Suction lift lines have been laid with a rising slope, suction head lines with a downward slope towards the pump.

NOTE

If site conditions do not allow the suction line to be laid with a rising slope, provide a venting facility at the highest point of this line.

✓ A flow stabilisation section having a length equivalent to at least twice the diameter of the suction flange has been provided upstream of the suction flange.

CAUTION

Dry running of the mechanical seal/pump malfunction

Damage to the pump!

- ▹ Route the suction line such that air pockets are prevented.
- ▹ The suction line must not leak.
- ▹ In order that the approach flow conditions and thus the NPSH of the system are not impaired, avoid installing narrow pipe bends and valves directly upstream of the pump.
- ▹ Install a foot valve for suction lift operation to prevent drainage of the suction line.

✓ The nominal diameters of the pipelines are equal to or greater than the nominal diameters 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 have been anchored in close proximity to the pump and connected without transmitting any stresses or strains.

NOTE

We recommend installing a shut-off element each in the suction line and discharge line, immediately upstream and downstream of the pump. This prevents the fluid handled from flowing back if the pump is stopped or removed for maintenance work. These shut-off elements must always be fully open when the pump is running; they must not be used for control duties. Operation against a closed gate valve will inevitably lead to damage to the pump/system.

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 covers on the suction nozzles and discharge nozzles of the pump.

DANGER

Excessive temperatures caused by welding beads, scale and other impurities in the piping

Explosion hazard!

Damage to the pump!

- ▹ Remove any impurities from the piping.
- ▹ If necessary, install a filter.
- ▹ Observe the relevant information. (⇨ Section 7.3.2.3, Page 55)

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3. If required, install a filter in the piping.

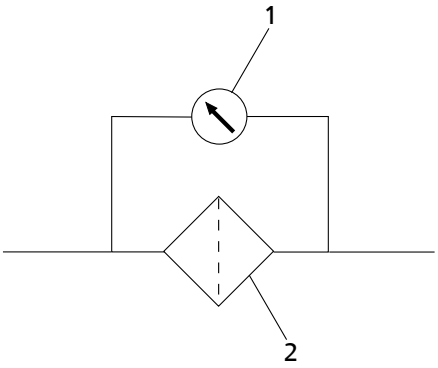

Fig. 10: Filter in the piping

1	Differential pressure gauge	2	Filter

NOTE

Use a filter with laid-in wire mesh (mesh width 0.5 mm, wire diameter 0.25 mm) of corrosion-resistant material.
Use a filter with a filter area three times the cross-section of the piping.
Conical filters have proved suitable.

4. Connect the pump nozzles to the piping.

CAUTION

Aggressive flushing liquid and pickling agent

Damage to the pump!

- ▷ Match the cleaning operation mode and duration of flushing and pickling to the casing materials and seal materials used.

5.4.2 Permissible forces and moments at the pump nozzles

No piping-induced forces and moments (from warped pipelines or thermal expansion, for example) must act on the pump.

If this is inevitable, the forces and moments must never exceed the values for F_{max} and M_{max} given in the following table.

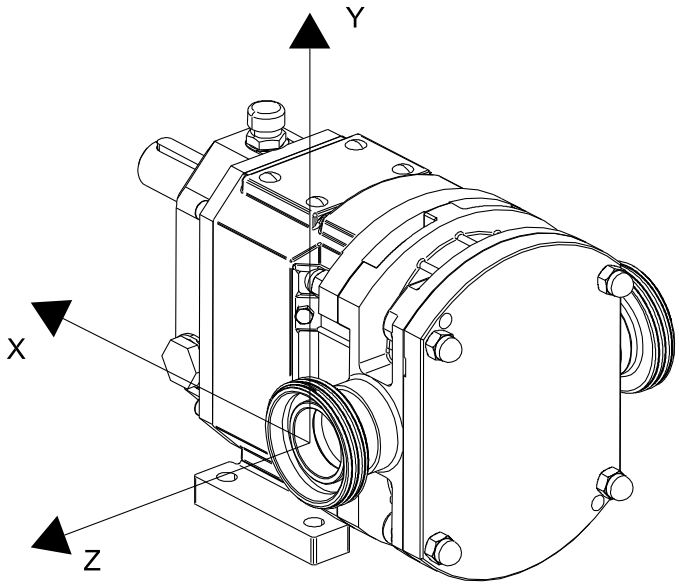

Fig. 11: Forces and moments at the pump nozzles

Table 9: Permissible forces at the pump nozzles

Size	Force [N]				Torque [Nm]			
	F_X	F_Y	F_Z	F_{max}	M_X	M_Y	M_Z	M_{max}
100	65	55	75	113	110	85	70	140
105/110/115	105	95	120	186	125	100	90	164
215	145	130	160	252	130	110	95	172
220	190	180	220	342	140	115	100	183
325	210	200	250	383	150	120	110	197
330/390	240	230	280	435	160	130	110	206
430/440	255	245	300	464	175	150	130	230
470/490	260	250	305	472	180	150	130	234
550	340	340	355	598	190	160	130	255
660/680	405	405	440	722	200	180	170	276

5.4.3 Auxiliary connections

The following auxiliary connections are available (depending on the pump design):

- Mechanical safety pressure relief valve (safety valve)
- Pneumatic safety pressure relief valve (safety valve)
- Bypass valve (safety valve)
- Quench connection for mechanical seal with flushing system
- Heating/cooling of the pump casing and/or casing cover

NOTE

The use of a safety valve is always recommended in order to ensure the pump's reliability in the event that an operator's error causes excess pressure peaks.

Table 10: Size of auxiliary connections for flushing and heating

	Size														
Description of auxiliary connections (internal thread)	**100**	**105 + 110**	**115**	**215**	**220**	**325**	**330**	**390**	**430**	**440**	**470**	**490**	**550**	**660**	**680**
Connection for flushing the mechanical seal	-	1/8 "	1/8 "	1/8 "	1/8 "	1/8 "	1/8 "	1/8 "	1/8 "	1/8 "	1/8 "	1/8 "	1/8"	1/4"	1/4"
Connection for heating the pump casing	-	1/2 "	1/2 "	1/2 "	1/2 "	1/2 "	1/2 "	1/2 "	1/2 "	1/2 "	3/4 "	3/4 "	3/4"	3/4"	3/4"
Connection for heating the casing cover	1/8 "	1/2 "	1/2 "	1/2 "	1/2 "	1/2 "	1/2 "	1/2 "	1/2 "	1/2 "	3/4 "	3/4 "	3/4"	3/4"	3/4"

5.4.3.1 Mechanical safety pressure relief valve

NOTE

The safety valve allows fluid to flow back from the discharge to the suction side of the rotary lobe pump and thus prevents excessive pressure build-up. The valve is spring-loaded. To prevent the valve from opening and closing excessively, it is recommended that the valve be set to respond at a pressure 10 % above the pump's operating pressure.

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	CAUTION
	Incorrect setting of safety pressure relief valve Malfunction of the pump! Damage to property and personal injury! ▷ The safety pressure relief valve must be set by the operator to suit the specific application, as its correct function (reliable return flow of fluid handled) depends on the rotational speed/flow rate of the pump and on the density and viscosity of the fluid handled.

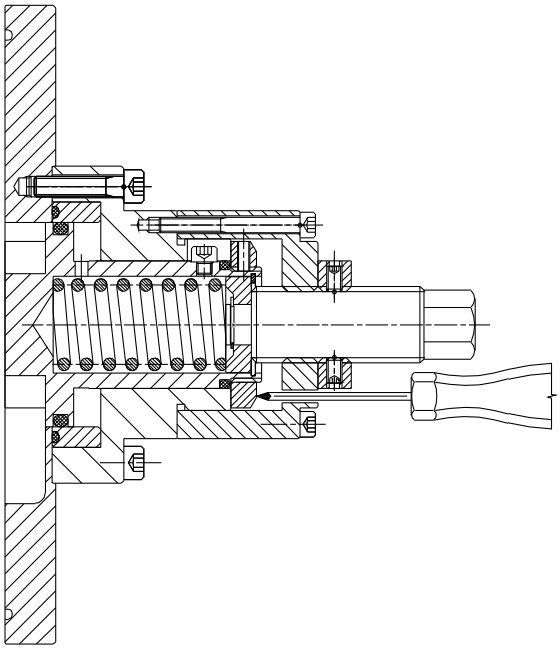

Fig. 12: Mechanical safety pressure relief valve (sectional drawing)

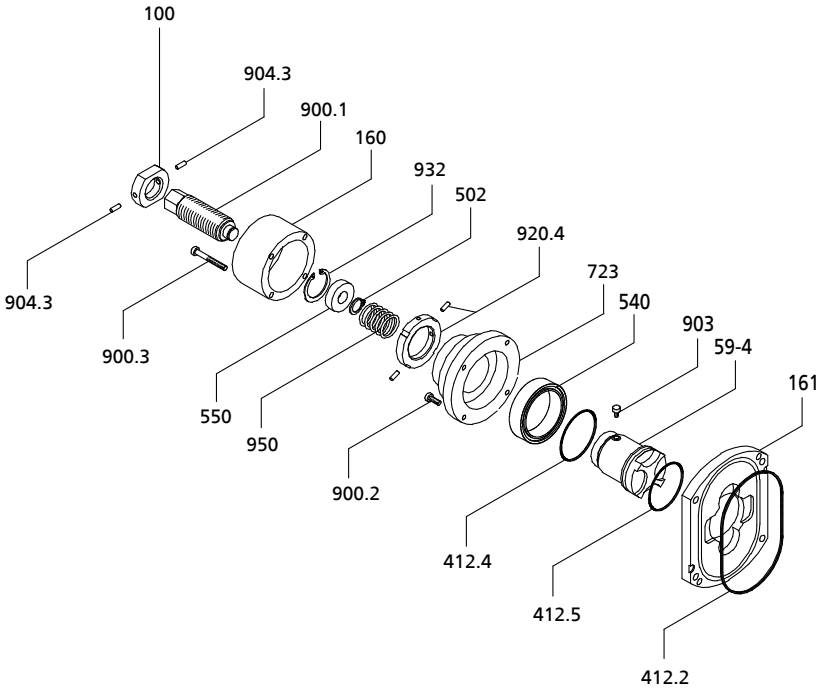

Fig. 13: Mechanical safety pressure relief valve (exploded view)

Setting the safety pressure relief valve

1. Relax the valve spring.
2. Start up the pump set.

3. Gradually tighten adjusting screw 900.1 to pre-load spring 950.
4. Determine the opening point by turning the adjusting screw and using a screwdriver (see Fig. Mechanical safety pressure relief valve (sectional drawing)). The screwdriver will be pressed out once the required pressure is reached.
5. Tighten the spring further by a quarter turn of the adjusting screw (beyond the critical opening pressure) to prevent excessive opening and closing of the safety pressure relief valve.
6. Position holder 100 and secure it with grub screw 904.3.

NOTE

The safety pressure relief valve can also be used to manually adjust the flow rate. To to so, loosen adjusting screw 900.1 and retract piston 59-4 from the pump chamber to allow some of the fluid to flow back.

CAUTION

No pressure gauges installed in suction and discharge line

Incorrect setting of the pressure relief valve!

Personal injury and damage to property!

- ▷ To set the exact differential pressure at which the safety pressure relief valve is to open, pressure gauges must be fitted in the suction line and discharge line, in order to read off the pressure upstream and downstream of the pump.

5.4.3.2 Pneumatic safety pressure relief valve

NOTE

The safety valve allows fluid to flow back from the discharge to the suction side of the rotary lobe pump and thus prevents excessive pressure build-up. The valve is controlled by air pressure. The pneumatic system controlling the valve can be selected with the help of the pressure curve. The pneumatic system must supply at least the air pressure determined from this curve. To prevent the valve from opening and closing excessively, setting the valve to a pressure 10 % above the pump's operating pressure is recommended.

CAUTION

Incorrect setting of safety pressure relief valve

Malfunction of the pump!

Damage to property and personal injury!

- ▷ The safety pressure relief valve must be set by the operator to suit the specific application, as its correct function (reliable return flow of fluid handled) depends on the rotational speed/flow rate of the pump and on the density and viscosity of the fluid handled.

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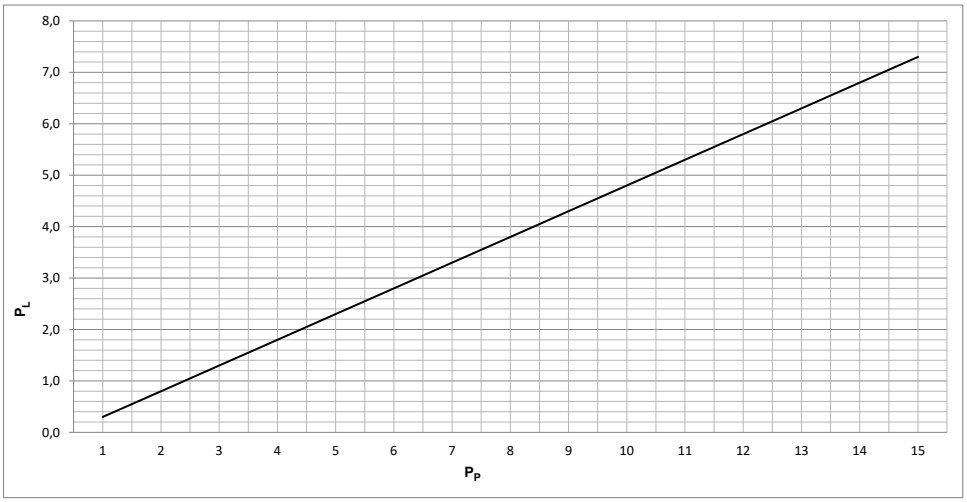

Fig. 14: Diagram of air pressure as a function of the operating pressure of the pump

P_L	Required air pressure	P_P	Operating pressure of the pump

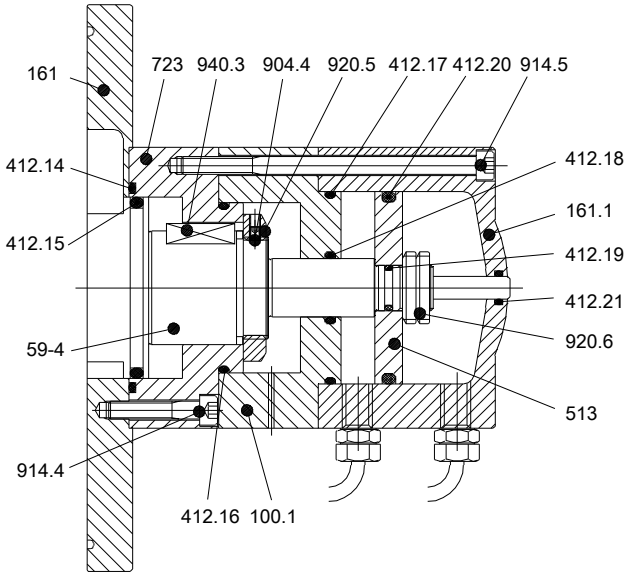

Fig. 15: Pneumatic safety pressure relief valve (sectional drawing)

Setting the pneumatic safety pressure relief valve

✓ To set the safety pressure relief valve, a pneumatic system (compressed air system) must be available at the place of use.

1. Connect the safety pressure relief valve to the compressed air system.
2. Start up the pump.
3. Apply pressure to the air side of the piston in the safety pressure relief valve.
4. Measure the pressure in the outlet line with a pressure gauge; increase/reduce the pressure supplied until the pressure in the outline line is zero (piston closed → no return flow).
5. To prevent excessive opening and closing of the safety pressure relief valve, increase the air pressure in the safety pressure relief valve to roughly 10 % above the critical opening pressure (opening of the safety pressure relief valve).

CAUTION

No pressure gauges installed in suction and discharge line

Incorrect setting of the pressure relief valve!

Personal injury and damage to property!

- ▷ To set the exact differential pressure at which the safety pressure relief valve is to open, pressure gauges must be fitted in the suction line and discharge line, in order to read off the pressure upstream and downstream of the pump.

5.4.3.3 Bypass valve

NOTE

The bypass line with its valve allows fluid to flow back from the discharge to the suction side of the rotary lobe pump and thus prevents excessive pressure build-up. The valve is spring-loaded. To prevent the valve from opening and closing excessively, setting the valve to a pressure 10 % above the pump's operating pressure is recommended.

CAUTION

Incorrect setting of safety pressure relief valve

Malfunction of the pump!

Damage to property and personal injury!

- ▷ The safety pressure relief valve must be set by the operator to suit the specific application, as its correct function (reliable return flow of fluid handled) depends on the rotational speed/flow rate of the pump and on the density and viscosity of the fluid handled.

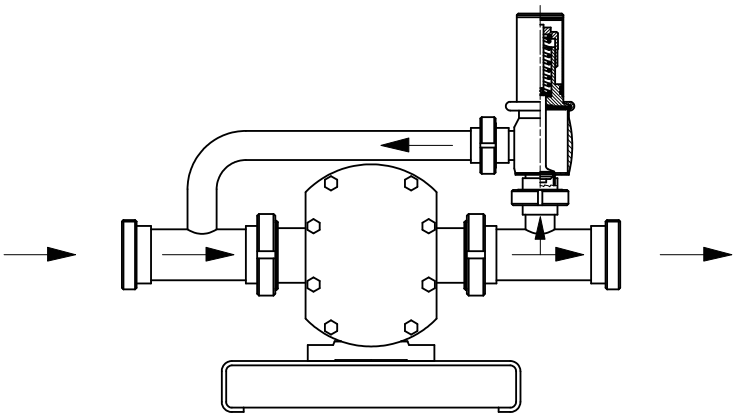

Fig. 16: Bypass valve

The bypass valve can be spring-loaded to the pressure at which it is to open, allowing fluid to flow back from the discharge to the suction nozzle. The closing pressure of the valve (spring pre-load) can be set directly at the valve. It should be approx. 10 % above the pump's operating pressure to prevent excessive opening and closing of the valve.

CAUTION

Incorrect bypass arrangement

Personal injury and damage to property!

- ▷ The bypass valve is uni-directional. Always make sure that the bypass leads from the discharge to the suction side and that the bypass valve is fitted on the discharge side only.

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5.4.3.4 Flushing connection for the mechanical seal

DANGER

Excessive temperatures caused by failure to use or incorrect use of auxiliary connections (flushing liquid)

Explosion hazard!

Malfunction of the pump!

- ▷ Use and install any auxiliary connections to ensure a proper flow.

DANGER

Excessive temperature caused by incorrect operation of the flushing system

Explosion hazard!

Malfunction of the pump!

- ▷ The flushing liquid must circulate correctly whenever the pump is running.
- ▷ The flushing fluid used must be compatible with the fluid handled by the pump.
  Incorrect operation of the flushing system will result in destruction of the mechanical seal and contamination of the fluid handled by the flushing fluid (and vice versa).
- ▷ The temperature difference between the flushing liquid and the fluid handled must not exceed 5 °C.

NOTE

Before using the pump for any fluids different from those originally specified, check that the mechanical seals and joint rings are suitable for that fluid.
If certified seal types or materials are used, the replacement seal must also have the required certification.

Flushing is used if the fluid handled tends to crystallise, or solidifies when in contact with the atmosphere. The flushing liquid may have a flow rate of approx. 0.5 to 1 l/min and a pressure of 0.5 to 1.0 bar (flushing pressure < pump pressure). In the case of double mechanical seals, the flushing pressure can be higher than the pressure inside the pump, allowing the flushing liquid to be used as a barrier fluid (for hazardous fluids).

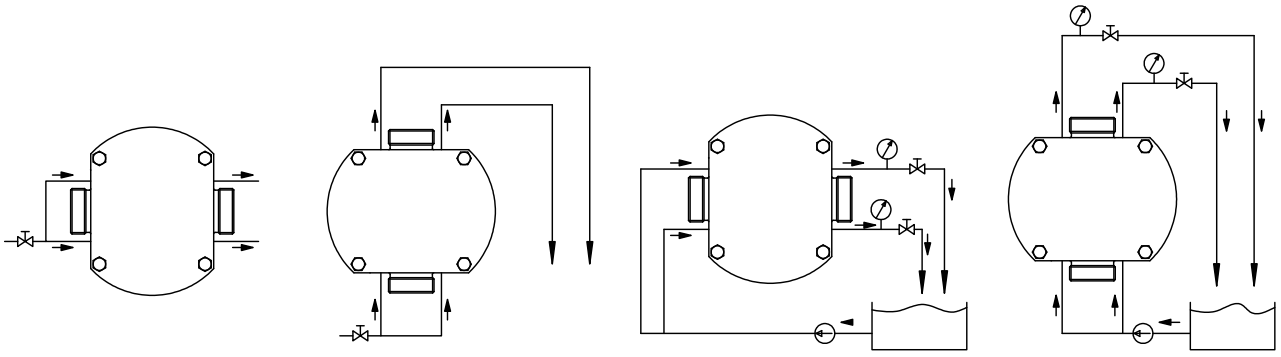

Fig. 17: Mechanical seal flushing system

1. Connect the flushing connections to the supply side and return side of the two mechanical seals.

5.4.3.5 Heating/cooling of pump casing

⚠ WARNING

The pump casing and cover take on the same temperature as the heating liquid

Risk of burns!

- ▷ Insulate the casing.
- ▷ Fit protective equipment.

The pump casing is heated/cooled by means of a liquid. To this end, the heating line must be connected to corresponding connections at the pump casing and casing cover. The heating system of the pump casing consists of two chambers. Liquid supply to the two chambers can either be carried out for each individual chamber or for the two chambers connected to each other.

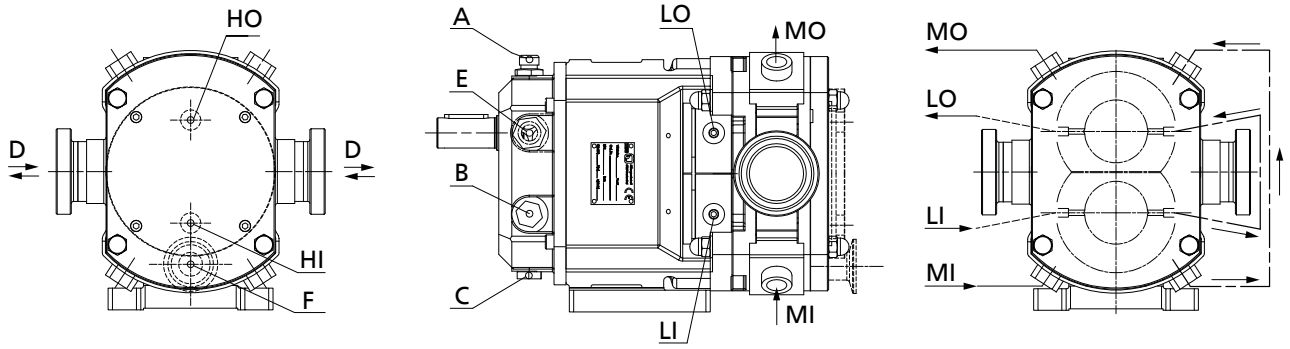

Fig. 18: Heating, inlet and outlet

A	Oil inlet and vent	HO	Heating outlet, casing cover
B	Bolted connection, gear cover	HI	Heating inlet, casing cover
C	Oil drain plug	LO	Flushing outlet, mechanical seal
D	Suction nozzle / discharge nozzle	LI	Flushing inlet, mechanical seal
E	Oil level sight glass	MO	Heating outlet, casing
F	Fluid drain nozzle	MI	Heating inlet, casing cover

5.5 Protective equipment

⚠ WARNING

The casing takes on the same temperature as the fluid handled

Risk of burns!

- ▷ Insulate the casing.
- ▷ Fit protective equipment.

⚠ WARNING

Failure to install protective equipment

Personal injury!

- ▷ Never operate the pump without protective equipment (contact guard and safety valve, if applicable).

CAUTION

Heat build-up at the bearing housing

Damage to the bearings!

- ▷ The bearing housings must not be insulated.

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The pump features the following permanent protective equipment:

- Protective cover (coupling guard) preventing unintentional contact with the coupling.
- Plexiglass cover preventing unintentional contact with the mechanical seal.

The pump set must never be operated without the coupling guard and, if provided, the plexiglass cover of the mechanical seal. Pump sets supplied with a motor shroud must never be operated without the motor shroud.

5.6 Checking the coupling alignment

DANGER

Inadmissible temperatures at the coupling or bearings due to misalignment of the coupling

Explosion hazard!

Risk of burns!

▷ Make sure that the coupling is correctly aligned at all times.

WARNING

Unprotected rotating coupling

Risk of injury by rotating shafts!

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

▷ Observe all relevant regulations for selecting a coupling guard.

CAUTION

Misalignment of pump and motor shafts

Damage to pump, motor and coupling!

▷ Always check the coupling after the pump has been installed and connected to the piping.

▷ Also check the coupling of pump sets supplied with pump and motor mounted on the same baseplate.

NOTE

Observe the supplementary operating instructions.

Radial misalignment

✓ The coupling guard (if any) has been removed.

1. Place the straight-edge axially on both coupling halves.
2. Leave the straight-edge in this position and turn the coupling by hand.
   The coupling is correctly aligned if the distance to the respective shafts is the same at all points around the circumference.
   The radial deviation between the two coupling halves must not exceed 0.4 mm, during standstill as well as at operating temperature and under inlet pressure.
3. Fit the coupling guard (if applicable).

Angular misalignment

1. Check for any angular misalignment by measuring the flange spacing with sliding callipers.

5.7 Electrical system

5.7.1 Frequency inverter operation

The pump set is suitable for operation on a frequency inverter as per IEC 60034-17.

Selection When selecting a frequency inverter, check the following details:

- Data provided by the manufacturer
- Electrical data of the pump set, particularly the rated current
- Only voltage source inverters (VSI) with pulse width modulation (PWM) and carrier frequencies between 1 and 16 kHz are suitable.

Setting Observe the following instructions for setting a frequency inverter:

- Set the current limit to max. 1.2 times the rated current. The rated current is indicated on the name plate.

Start-up Observe the following instructions for starting the frequency inverter:

- Ensure short start ramps (maximum 5 seconds).

Operation Observe the following limits during operation on a frequency inverter:

- Only utilise up to 95 % of the motor rating P_2 indicated on the name plate.
- Do not exceed the maximum pump speed (depending on its size).
- Frequency range 25 to 60 Hz

Electromagnetic compatibility Operation on a frequency inverter produces interference emissions whose level varies depending on the inverter used (type, interference suppression, make). To prevent the drive system, consisting of a submersible motor and a frequency inverter, from exceeding any given limits always observe the EMC information provided by the inverter manufacturer. If the inverter manufacturer recommends a shielded power cable, make sure to use a submersible motor pump with shielded power cables.

Interference immunity The submersible motor pump generally meets interference immunity requirements. For monitoring the sensors installed the operator must ensure sufficient interference immunity by appropriately selecting and laying the power cables in the plant. No modifications are required on the power/control cable of the submersible motor pump. Suitable analysing devices must be selected. To monitor the leakage sensor inside the motor using a special relay available from KSB is recommended.

CAUTION

Motor overheating if operated in low-frequency range

Damage to the pump!

▷ For operation in a low-frequency range cool the motor with an external fan.

An external fan is required when the torque is high but the rotational speed of the motor and, consequently, the motor fan are low (e.g. in a highly viscous fluid). Always check if an external fan is required prior to setting the speed to a level outside of the indicated speed range. This depends on the cooling capacity of the motor fan and on the torque required, which determines the nominal motor current.

5.8 Electrical connection

DANGER

Electrical connection work by unqualified personnel

Risk of fatal injury due to electric shock!

▷ Always have the electrical connections installed by a trained and qualified electrician.

▷ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.

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⚠ WARNING

Incorrect connection to the mains

Damage to the mains network, short circuit!

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

1. Check the available mains voltage against the data on the motor data sheet.
2. Select an appropriate starting method.
3. If applicable, connect the electric control unit.

NOTE

A motor protection device is recommended.

5.8.1 Connecting the motor

NOTE

The pump can be operated in both directions. Select the motor's direction of rotation such that the fluid is pumped in the flow direction required.

In compliance with DIN VDE 0530 - Part 8, three-phase motors are always wired for clockwise rotation (looking at the motor shaft stub).

1. Connect the motor in star or delta configuration in accordance with the purchase order data/motor data.
2. Observe the manufacturer's product literature supplied with the motor.

5.8.2 Earthing

⚠ DANGER

Electrostatic charging

Explosion hazard!

Fire hazard!

Damage to the pump set!

▷ Connect the PE conductor to the earthing terminal provided.

5.9 Checking the direction of rotation

⚠ WARNING

Hands inside the pump casing

Risk of injuries, damage to the pump!

▷ Always disconnect the pump set from the power supply and secure it against unintentional start-up before inserting your hands or other objects into the pump.

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 properly connected to the electric power supply and is equipped with all protection devices. (Refer to the information provided on the motor and/or control unit.)
- All protective equipment (coupling guards, etc.) has been fitted.
- All screwed connections have been tightened properly.
- The pump has been primed with the fluid to be pumped.
  (⇨ Section 6.1.3, Page 41)
- The pipelines have been connected without warping the pump nozzles.
- The lubricants have been checked and topped up, if necessary.
  (⇨ Section 7.3.3, Page 55)
- All auxiliary connections required are connected and operational.
- The direction of rotation has been checked. (⇨ Section 5.9, Page 39)
- The quality of the concrete foundation complies with the regulations.
- The pump set has been installed and aligned in accordance with the tolerances specified.
- The flexible element has been checked for correct seating.
- The flanges have been checked for correct seating.
- The flexible ring has been checked for correct seating.
- After prolonged shutdown of the pump (set), the required activities have been carried out. (⇨ Section 6.3, Page 47)

6.1.2 Filling in the lubricant

The pump/pump set is supplied filled with lubricant. Both the synchronisation gear and the bearings of both shafts run in an oil bath. The oil level can be checked at the sight glass on the pump's bearing housing. The bearing housing can be topped up with lubricant as required. To do so, undo and remove screw plug 903.1. With the pump stopped, the sight glass must be completely filled with oil.

Top up the oil in the bearing housing and gear unit.
Oil quality see (⇨ Section 7.3.3.2.2, Page 56)
Oil quantity see (⇨ Section 7.3.3.2.3, Page 56)

CAUTION

Insufficient lubricating oil in gear unit / bearing housing

Damage to gear wheels and bearings!

▷ Check the oil level at the sight glass regularly and top it up if necessary.

NOTE

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

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6.1.3 Priming and venting the pump

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.

DANGER

Risk of potentially explosive atmosphere inside the pump

Explosion hazard!

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

CAUTION

Increased wear due to dry running

Damage to the pump set!

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

1. Vent the pump and suction line and prime both with the fluid to be handled.
2. Fully open the shut-off element in the suction line.
3. Fully open all auxiliary feed lines (barrier fluid, flushing liquid, etc.), if any.

NOTE

For design-inherent reasons some unfilled volume in the hydraulic system cannot be excluded after the pump has been primed for commissioning/start-up. However, once the motor is started up the pumping effect will immediately fill this volume with the fluid handled.

6.1.4 Start-up

DANGER

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

Explosion hazard!

Leakage of hot or toxic fluids!

- Never operate the pump with the shut-off elements in the suction line and/or discharge line closed.

DANGER

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

Explosion hazard!

Damage to the pump set!

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

DANGER

Permissible pressure limits exceeded

Explosion hazard!

- ▹ The pump must exclusively be used with the corresponding safety pressure relief valves / bypass. (⇨ Section 5.4.3, Page 30)

CAUTION

Abnormal noises, vibrations, temperatures or leakage

Damage to the pump!

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

- ✓ The system piping has been cleaned.
- ✓ Pump, suction line and inlet tank, if fitted, have been vented and primed with the fluid to be pumped.
- ✓ The lines for priming and venting have been closed.

WARNING

Starting and operating the pump against a closed discharge line

Personal injury and damage to property!

- ▹ Never operate the pump against a closed discharge line. Pumping against a closed shut-off element will cause severe heat build-up and a sharp increase in pressure.

1. Fully open the shut-off element in the suction head/suction lift line.
2. Fully open the shut-off element in discharge line.
3. If a mechanical seal / gland packing with quench/flushing system is used, make sure that the quench/flushing liquid circulates properly.
4. Start up the motor.

NOTE

If possible, start up the pump with reduced speed, then increase speed slowly until the nominal speed is reached, and check for any disturbances (pressure overload, cavitation, vibration, etc.).

NOTE

If the discharge pressure/discharge head does not increase after pump start-up, switch off the pump, vent it and repeat steps 1 to 4.

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6.1.5 Checking the shaft seal

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

Shaft seal ring Shaft seal rings leak only slightly or not at all during operation. Shaft seal rings are maintenance-free.

6.1.6 Shutdown

⚠ WARNING

Starting and operating the pump against a closed discharge line

Personal injury and damage to property!

- ▷ Never operate the pump against a closed discharge line. Pumping against a closed shut-off element will cause severe heat build-up and a sharp increase in pressure.

CAUTION

Heat build-up inside the pump

Damage to the shaft seal!

- ▷ Depending on the type of installation, the pump set requires sufficient after-run time – with the heat source switched off – until the fluid handled has cooled down.

1. Switch off the pump and make sure the pump set runs down smoothly to a standstill.
2. Close the shut-off element in the discharge line.
3. Close the shut-off element in the suction line.
4. Make sure that pump pressure has been released.

For prolonged shutdown periods:

1. Close all auxiliary feed lines (flushing/quench, compressed air (pneumatic safety pressure relief valve), etc.), if fitted.

CAUTION

Risk of freezing during prolonged pump shutdown periods

Damage to the pump!

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

6.1.7 Seal supply system

6.1.7.1 Requirements to be met by the seal supply system

Pipework routing requirements When routing pipework and flexible tubing, prevent any high points or ensure that high points can be vented separately to prevent dry running of the mechanical seal. The connecting pipes between the main pipe and the pump must be routed with a continuously rising slope to assure self-venting of the pipe and the mechanical seal, respectively.

6.1.7.2 Types of seal supply systems

Which of the two types of seal supply systems is used depends on the mechanical seal:

6.1.7.2.1 Quench liquid

6.1.7.2.1.1 Applications

A quench liquid is used in the following cases:

- Where a single mechanical seal without supportive measures would not work at all or unsatisfactorily.
- Where a double mechanical seal design with pressurised barrier fluid is not required.

6.1.7.2.1.2 Quench liquid requirements

The quench liquid should preferably form a solution with the fluid handled and be environmentally compatible.

Typical quench liquids

- Water with a conductivity of 100 - 800 µS/cm
- Water/glycol mixture
- Glycerine[4)]

The quench liquid should be supplied with a pressure of 1.5 - 2.0 bar (flushing pressure < pressure inside the pump).

The one-way quench supply should be adjusted to a constant flow 0.5 - 1 l/min.

Periodically check the quench liquid for contamination (replace quench liquid and clean quench system if necessary).

6.1.7.2.1.3 Applications

For seal arrangement VG (flushed seal)

6.1.7.2.2 Barrier fluid system

6.1.7.2.2.1 Applications

Barrier fluid systems serve to:

- Dissipate friction heat
- Prevent the fluid handled from entering the sealing gap

6.1.7.2.2.2 Barrier fluid requirements

The barrier fluid should preferably form a solution with the fluid handled and be environmentally compatible. The barrier fluid should be monitored: Any ingress of the fluid handled can be identified at an early stage by the barrier fluid becoming turbid.

The temperature differences between the barrier fluid and the fluid handled must not exceed 5 °C. A general minimum temperature of 0 °C applies to the barrier fluid.

The barrier fluid system must be set to a pressure which exceeds the pressure inside the pump by approximately 1 bar. The flow rate of the barrier fluid must equal approximately 0.5 to 1 l/min.

6.1.7.2.2.3 Applications

For seal type Q, operating mode DB

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4 Make sure the circulation line diameter is ≥ ¼".

6.2 Operating limits

DANGER

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

Explosion hazard!

Hot or toxic fluid could escape!

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

DANGER

Formation of a potentially explosive atmosphere inside the pump

Explosion hazard!

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

6.2.1 General operating limits

- Up to 24 hours of operation per day
- Operation with the specified coupling alignment (⇨ Section 5.6, Page 37)

6.2.2 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 11: Permissible ambient temperatures

Permissible ambient temperature	Value
Maximum	40 °C
Minimum	See data sheet.

6.2.3 Operating temperature

Table 12: Permissible operating temperature

Permissible operating temperature	Value
Maximum	180 °C
Minimum	-40 °C

6.2.4 Frequency of starts

CAUTION

Re-starting while motor is still running down

Damage to the pump (set)!

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

The frequency of starts is usually determined by the maximum temperature increase of the motor. This largely depends on the power reserves of the motor in steady-state operation and on the starting conditions (DOL, star-delta, moments of inertia, etc). If the start-ups are evenly spaced over the period indicated, the pump set can be started up six times per hour (h).

6.2.5 Fluid handled

6.2.5.1 Flow rate

The calculation formula below can be used to check if an additional heat build-up could lead to a dangerous temperature increase at the pump surface.

$T_O = T_f + \Delta\vartheta$

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

Table 13: 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	-
$\Delta\vartheta$	Temperature difference	K

6.2.5.2 Density of the fluid handled

CAUTION

Impermissibly high density of the fluid handled

Motor overload!

- ▷ Observe the information about fluid density in the data sheet.
- ▷ Make sure the motor has sufficient power reserves.

6.2.5.3 Viscosity of the fluid handled

The discharge head, flow rate and power input of the pump are influenced by the viscosity of the fluid handled.

CAUTION

The fluid handled has a higher viscosity than permitted.

Risk of motor overload!

- ▷ Observe the viscosity limits for the fluid handled given in the data sheet.
- ▷ Make sure the motor has sufficient power reserves.

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6.2.5.4 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.

DANGER

Abraded casing wall

Explosion hazard!

- ▹ Adjust the inspection intervals to the increased abrasion.
- ▹ For combustible fluids: The fluids must not contain any abrasive particles.

6.2.6 Operating data

Table 14: Operating properties

Size	Rated torque T_{CN}	Power					Max. speed	Static torsional stiffness	
		[kW] per 100 rpm							
	[Nm]	fs 1	fs 1.5	fs 2	fs 2.5	fs 3	[rpm]	[Nm/°]	[Nm/rd]
SF3	41,5	0,42	0,28	0,21	0,17	0,14	3600	3,44	197,7
SF4	94,6	0,96	0,64	0,48	0,38	0,32	3600	7,34	421,8
SF5	162,7	1,65	1,1	0,82	0,66	0,55	3600	12,1	692
SF6	255,5	2,58	1,72	1,29	1,03	0,86	1800	16,3	935,8
SF7	380,6	3,85	2,57	1,93	1,54	1,28	1800	23,3	1351

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.

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

✓ The pump has been properly drained (⇨ Section 7.4, Page 57) and the safety instructions for dismantling the pump have been observed.

1. Spray-coat the inside wall of the pump casing with a preservative, particularly in the clearances around the rotors.
2. Spray the preservative through the suction and discharge nozzles.
   It is advisable to then close the pump nozzles (e.g. with plastic caps or similar).
3. Oil or grease all exposed machined parts and surfaces of the pump (with silicone-free oil and grease, food-approved, if required) to protect them against corrosion.
   Observe the additional instructions.
4. Store the pump in a dry and protected location, preferably at room temperature (approx. 20 °C).

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

Observe any additional instructions and information provided. (⇨ Section 3, Page 13)

6.4 Returning to service

For returning the equipment to service, observe the sections on commissioning/start-up (⇨ Section 6.1, Page 40) and the operating limits .

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

⚠ WARNING

Failure to re-install or re-activate protective devices

Risk of injury from moving parts or escaping fluid!

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

NOTE

If the equipment has been out of service for more than one year, replace all elastomer seals before returning the equipment to service.

Verify that the type of the new elastomers (material, certification) corresponds with that of the previous ones.

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7 Servicing/Maintenance

7.1 Safety regulations

DANGER

Sparks produced during servicing work

Explosion hazard!

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

DANGER

Insufficient preparation of work on the pump (set)

Risk of injury!

- Properly shut down the pump set.
- Close the shut-off elements in the suction line and discharge line.
- Drain the pump and release the pump pressure.
- Shut off any auxiliary connections.
- Allow the pump set to cool down to ambient temperature.

DANGER

Improperly serviced pump set

Explosion hazard!

Damage to the pump set!

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

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

WARNING

Liquids escaping at high pressure

Risk of injury!

- Depressurise the pump.

WARNING

Unintentional starting of the pump set

Risk of injury by moving components and shock currents!

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

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⚠ WARNING

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

Risk of injury!

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

⚠ WARNING

Insufficient stability

Risk of crushing hands and feet!

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

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

NOTE

All maintenance work, service work and installation work can be carried out by KSB Service or authorised workshops. 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.

⚠ WARNING

Failure to re-install or re-activate protective devices

Risk of injury from moving parts or escaping fluid!

- ▷ As soon as the work is completed, re-install and/or re-activate any safety-relevant and protective devices.

7.2 Cleaning

As Vitalobe pumps are designed for hygienic applications (Level 1 (Vitalobe B), Level 3 (Vitalobe BB) to EN 13951), they must be cleaned regularly both internally and externally.

7.2.1 Cleaning in place (CIP)

1. If the pump is equipped with a safety pressure relief valve, the safety pressure relief valve's opening pressure must be set just below the CIP system pressure so that the safety pressure relief valve is open during the cleaning process.
2. If the pump is equipped with a heating and/or flushing system, make sure that these systems are connected and working properly.

⚠ WARNING

Incorrect setting of safety pressure relief valve

Personal injury and damage to property!

- ▷ After CIP cleaning the safety pressure relief valve must be set back to its original pressure. (⇨ Section 5.4.3, Page 30)

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CAUTION

Elastomers do not have sufficient resistance

Damage to the pump!

▷ Effect cleaning/sterilisation only if the elastomer components used in the pump (e.g. O-rings, mechanical seals) are made of EPDM or other approved materials.

Application CIP may be effected with the pump running **slowly**.
Recommended flow velocity: between 1.5 and 3 m/s

Cleaning agents When performing CIP in the system the pump set is installed in, comply with the concentration limits, temperature limits and contact times given below for the cleaning agents and disinfectants:

Table 15: Cleaning agents for CIP

Cleaning agents	Concentration [Weight %]	Temperature t [°C]
Sodium hydroxide (soda lye)	1-3	70-90
Phosphoric acid	0,5	45
Lye, alkaline	5	95
Nitric acid	1-2,5	45
Citric acid	0,5-3	70

Recommended cleaning process

1. Flush with cold water (15 - 25 °C) for 10 to 15 minutes to remove all residues.
2. Flush with hot water (45 - 60 °C) for 10 minutes.
3. Flush with lye (70 - 95 °C) for 20 to 30 minutes.
4. Flush with water (max. 60 °C) for 5 to 10 minutes.
5. Flush with one of the above acids at the respective temperature for 10 to 15 minutes.
6. Finally, flush with cold water for 10 to 15 minutes until all cleaning agents have been removed.

NOTE

In the event of sudden large temperature fluctuations (delta T < 40 °C) the difference in thermal expansion can lead to the rotor rubbing against the casing. To prevent this, prime the pump with the fluid to be handled next while the pump is in standstill. Then wait for 2 minutes before starting up the pump.
For very large temperature fluctuations increase the waiting period before starting up the pump.

7.2.2 SIP (steaming in place)

1. If the pump is equipped with a safety pressure relief valve, the safety pressure relief valve's opening pressure must set just below the SIP system pressure so that the safety pressure relief valve is open during the cleaning process.
2. If the pump is equipped with a heating and/or flushing system, make sure that these systems are connected and working properly.

⚠ WARNING

Incorrect setting of safety pressure relief valve

Personal injury and damage to property!

▷ After SIP cleaning the safety pressure relief valve must be set back to its original pressure. (⇨ Section 5.4.3, Page 30)

⚠ WARNING

Pump casing takes on the same temperature as the sterilisation fluid

Risk of burns!

- ▹ Fit additional protective devices.
- ▹ Observe the general safety rules and regulations for steam applications.

CAUTION

Elastomers do not have sufficient resistance

Damage to the pump!

- ▹ Effect cleaning/sterilisation only if the elastomer components used in the pump (e.g. O-rings, mechanical seals) are made of EPDM or other approved materials.

CAUTION

SIP with the pump running

Damage to the mechanical seals!

- ▹ Effect SIP (cleaning using superheated steam) only if the pump has been switched off.

CAUTION

Rubbing contact of rotors in the casing after SIP

Damage to the pump!

- ▹ After SIP let the pump cool down to ambient temperature to prevent any damage to the pump based on a difference in heat expansion inside the pump casing.

Limits **Table 16:** SIP temperature requirements

Elastomer	Saturated steam	Chemical agent
EPDM	121 °C	82 °C
FPM/FKM	149 °C	82 °C

7.3 Servicing/Inspection

7.3.1 Supervision of operation

⚠ DANGER

Risk of potentially explosive atmosphere inside the pump

Explosion hazard!

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

⚠ DANGER

Permissible pressure limits exceeded

Explosion hazard!

- ▹ The pump must exclusively be used with the corresponding safety pressure relief valves / bypass. (⇨ Section 5.4.3, Page 30)

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DANGER

Incorrectly serviced shaft seal

Explosion hazard!

Hot, toxic fluid escaping!

Damage to the pump set!

Risk of burns!

Fire hazard!

- ▷ Regularly service the shaft seal.

DANGER

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

Explosion hazard!

Fire hazard!

Damage to the pump set!

- ▷ Regularly check the rolling element bearings for running noises.

CAUTION

Increased wear due to dry running

Damage to the pump set!

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

CAUTION

Impermissibly high temperature of fluid handled

Damage to the pump!

- ▷ Operation against a closed shut-off element is not permitted (heating up of the fluid handled).
- ▷ Observe the temperature limits in the data sheet and in the section on operating limits.

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

- The pump must run quietly and free from vibrations at all times.
- Check the shaft seal. (⇨ Section 6.1.5, Page 43)
- In case of oil lubrication, ensure the oil level is correct. (⇨ Section 6.1.2, Page 40)
- Check the static seals for leakage.
- Check the rolling element bearings for running noises.
  Vibrations, noise and an increase in current input occurring during unchanged operating conditions indicate wear.
- Monitor the correct functioning of any auxiliary connections.
- Monitor the stand-by pump.
  To make sure that 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 at the bearing housing).
- On oil-lubricated models the bearing temperature can be measured in the oil sump. The alert limit is 100 °C. Never exceed 110 °C (pump trip).

CAUTION

Operation outside the permissible bearing temperature

Damage to the pump!

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

NOTE

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

7.3.2 Inspection work

⚠ DANGER

Static charging due to insufficient potential equalisation

Explosion hazard!

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

Daily inspection

- Visually inspect all seal components for leakage. If leakage is detected, replace the relevant components as quickly as possible.

Weekly inspection

- Check the oil level at the bearing housing and gear unit; top up if necessary. Check the bearing seal.
- Check and clean the rotor casing. Remove any residues of the fluid handled.
- Check the rotor clearances. (⇨ Section 7.3.2.2, Page 54)
- Check and ensure the correct function of the safety pressure relief valve.

Half-yearly inspection

- If the pump is constantly operating at a fluid temperature above 100 °C, check the quality of the lubricating oil. Replace it if necessary.
- Check the synchronisation of the gear wheels in the gear unit.
- Check the bearing clearances at the drive shafts. Replace the bearings if necessary.
- Check the bearing housing for damage (corrosion).

7.3.2.1 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.

7.3.2.2 Checking the clearances

✓ There are noises and vibrations which suggest that the rotating rotors are touching the pump casing/cover.

1. Remove the casing cover, the rotors and the pump casing.
2. Examine the casing, rotors and cover for signs of seizure or rubbing contact.
3. Smoothen any signs of seizure or rubbing contact using a polishing cloth.

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4. Re-adjust the clearances and re-synchronise the rotors.
   (⇨ Section 7.6.2, Page 74)
5. Fit the pump casing, rotors and casing cover.

7.3.2.3 Cleaning filters

CAUTION

Insufficient inlet pressure due to clogged filter in the suction line

Damage to the pump!

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

7.3.2.4 Checking the quench liquid

Periodically check the quench liquid for contamination.
Drain the quench liquid, if required. Clean the quench system and fill with new quench liquid.

7.3.2.5 Checking the bearing seals

Regularly check the sealing elements at the bearing housing and gear unit for leakage. Replace any leaking sealing elements immediately.

7.3.3 Lubrication and lubricant change of rolling element bearings

DANGER

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

Explosion hazard!

Fire hazard!

Damage to the pump set!

- ▷ Regularly check the condition of the lubricant.

7.3.3.1 Bearing life

Table 17: Bearing life

Size Vitalobe	Service life [h]
100	10000
105	10000
110	10000
115	5000
215	5000
220	5000
325	5000
330	5000
430	5000
440	5000
470	5000
490	5000
550	10000

Size Vitalobe	Service life [h]
660	10000
680	10000

7.3.3.2 Oil lubrication

The gearbox and the rolling element bearings are lubricated with mineral oil.

7.3.3.2.1 Intervals

Table 18: Oil change intervals

Temperature at the bearing	First oil change	All subsequent oil changes[5)]
Up to 90 °C	After 150 operating hours	Every 2500 operating hours
> 90 °C	After 150 operating hours	Every 1000 operating hours

7.3.3.2.2 Oil quality

Table 19: Oil quality

Brand	Operating temperature	
	-20 °C to +90 °C (viscosity ISO VG 68)	+90 °C to +150 °C (viscosity ISO VG 150)
ESSO	SPARTAN EP 68	SPARTAN EP 150
SHELL	OMALA OIL 68	OMALA OIL 150
CASTROL	ALPHA SP 68	ALPHA SP 150
BP	ENERGOL GR-XP 100	ENERGOL GR-XP 150
MOBIL	MOBILGEAR 626	MOBILGEAR 629
AGIP	BLASIA 68	BLASIA 150
FINA	GIRAN 100	GIRAN 150

NOTE

If necessary for hygiene reasons, food-approved oil of the required quality can be used (e.g. Kluberoil 4 UH1-68N).

7.3.3.2.3 Oil quantity

Table 20: Oil quantity

Size	Oil quantity [l]
100	0,2
105, 110, 115	0,5
215, 220	1,0
325, 330, 390	2,2
430, 440	4,5
470, 490	6,7
550	15,0
660/680	30,0

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5 At least once a year

CAUTION

Insufficient lubricating oil in gear unit / bearing housing

Damage to gear wheels and bearings!

- ▷ Check the oil level at the sight glass regularly and top it up if necessary.

NOTE

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

7.3.3.2.4 Changing the oil

⚠ WARNING

Lubricants posing a health hazard and/or hot lubricants

Hazard to persons and the environment!

- ▷ 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.

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

1. Place the container underneath oil drain plug 903.2.
2. Undo and remove oil drain plug 903.2. Drain the oil.
3. Once the bearing housing has been drained, re-insert and re-tighten oil drain plug 903.2.
4. Open screw plug 903.1.
5. Re-fill with oil.
6. Close screw plug 903.1 again.

7.4 Drainage/cleaning

⚠ WARNING

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

Hazard to persons and the environment!

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

1. For draining the fluid handled open the casing cover or, if applicable, open the residual-drainage valve.

NOTE

If the pump is operated with vertically positioned nozzles it can be drained very easily through the bottom nozzle.

2. Always flush the system if it has been used for handling noxious, explosive, hot or other hazardous fluids.
   Flush and clean the pump before transporting it to the workshop. Provide a cleaning record for the pump.

7.5 Dismantling the pump set

7.5.1 General information/Safety regulations

⚠ WARNING

Unqualified personnel performing work on the pump (set)

Risk of injury!

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

⚠ WARNING

Hot surface

Risk of injury!

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

⚠ 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.

Observe the general safety instructions and information.

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

For dismantling and reassembly observe the exploded views and the general assembly drawing.

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

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.

⚠ DANGER

Insufficient preparation of work on the pump (set)

Risk of injury!

- ▷ Properly shut down the pump set.
- ▷ Close the shut-off elements in the suction line and discharge line.
- ▷ Drain the pump and release the pump pressure.
- ▷ Shut off any auxiliary connections.
- ▷ Allow the pump set to cool down to ambient temperature.

NOTE

After a prolonged period of operation the individual components may be hard to pull off the shaft. If this is the case, use a brand name penetrating agent and/or - if possible - an appropriate puller.

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NOTE

Special tools are required for proper dismantling and reassembly. The corresponding tool kit can be hired or purchased from KSB Service GmbH.

7.5.2 Preparing the pump set

1. De-energise the pump set and secure it against unintentional start-up.
2. Reduce pressure in the piping by opening a consumer installation.
3. Disconnect and remove all auxiliary pipework.

7.5.3 Removing the complete pump set from the piping

NOTE

First, remove any auxiliary connections (safety pressure relief valve, heating, flushing system) from the pump.

1. Disconnect the discharge and suction nozzles from the piping.
2. Depending on the pump/motor size, unscrew the bolts that fix the support foot and/or motor foot to the foundation.
3. Remove the complete pump set from the piping.

7.5.4 Dismantling the pump

DANGER

Rotors rubbing against the casing

Damage to the pump set!

Rotor screws 900 are secured with grub screws 904.4 (design Vitalobe B). Make sure to fit them again during reassembly.

1. Unbolt the pump from the baseplate.
2. Remove the coupling guard and coupling.
3. Remove the pump with suitable lifting equipment.

7.5.4.1 Vitalobe size 100

CAUTION

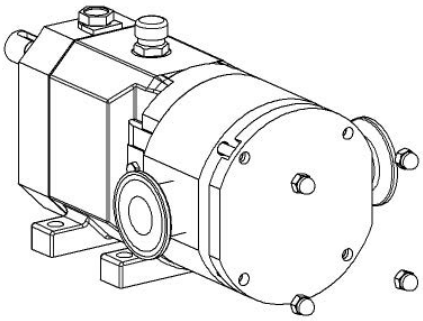
Damage to seal faces and O-rings

Damage to the mechanical seal!

- ▹ Always handle the mechanical seal with utmost care.

✓ The pump set has been removed and placed in a level and clean assembly area.

✓ Assembly tools are on hand.



1. Remove nuts 920.1. Take off casing cover 161 with O-ring 412.2.
2. If cover plates 680 are fitted, undo hexagon head bolts 901.2 and remove the cover plates.

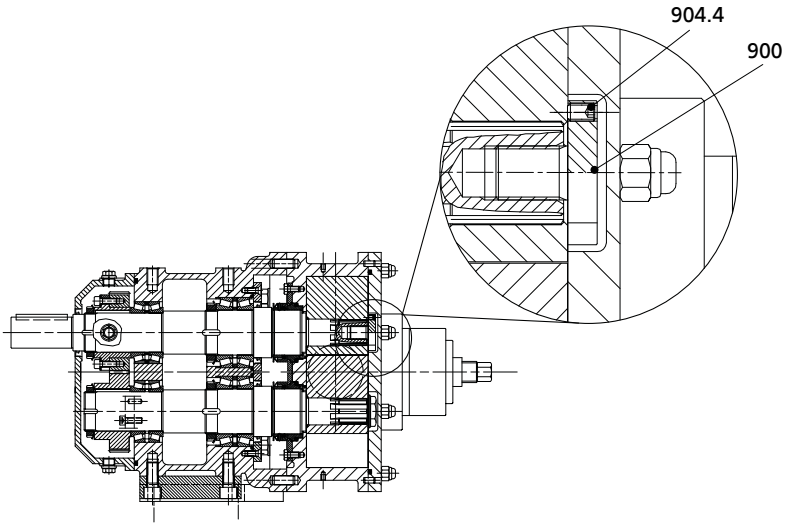
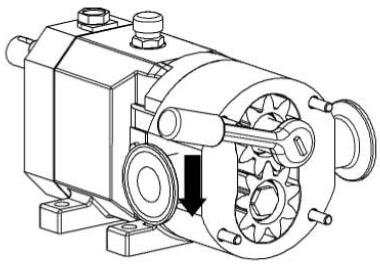
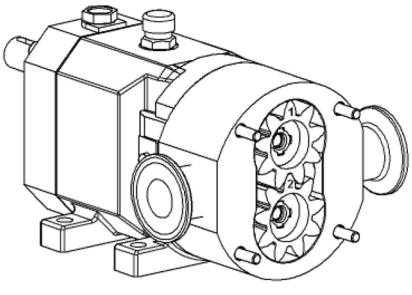


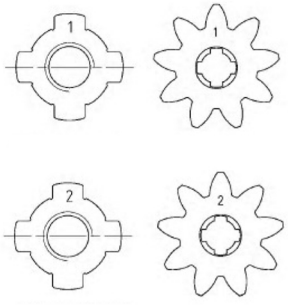
Fig. 19: Rotor screw locking system (on pumps with ATEX certification only)

3. Remove and store grub screws 904.4.

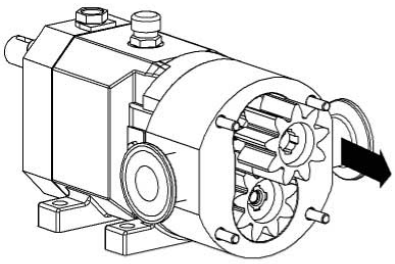


4. Undo rotor screws 900.
   ⇨ To do so, block rotors 123-15 with a non-metallic object.
5. Remove O-rings 412.1.

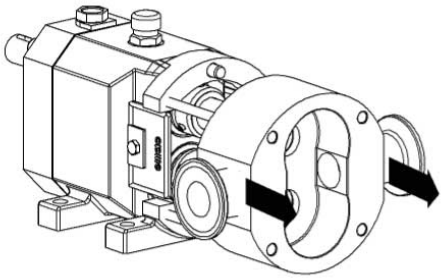




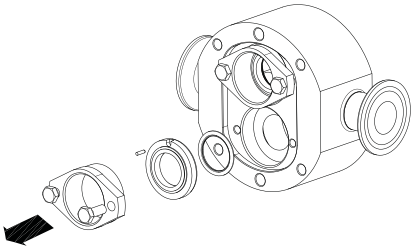
6. Mark rotors 123-15 and drive shafts 213.1/213.2.



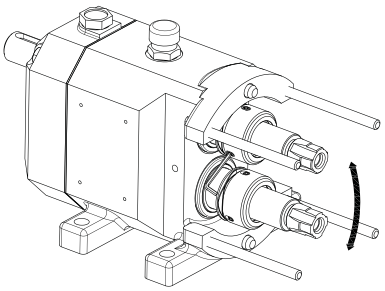
7. Remove rotors 123-15.



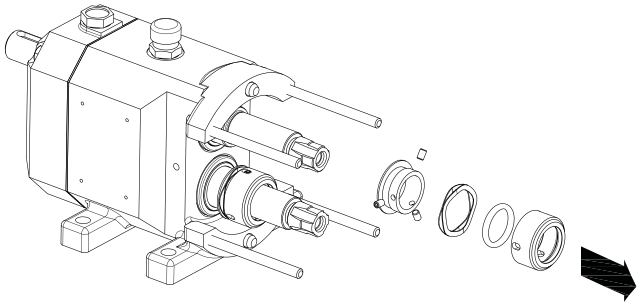
8. Pull off rotor casing 100.



9. Undo hexagon head bolt 901.1. Take off seal cover 471.1. Remove the mating rings of mechanical seals 433 from rotor casing 100.

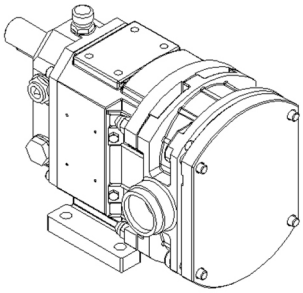


10. Undo the grub screws of mechanical seals 433.



11. Take the primary rings of mechanical seals 433 off shafts 213.1/213.2.

7.5.4.2 Vitalobe sizes 105 to 490



1. Remove nuts 920.1. Take off casing cover 161 with O-ring 412.2.
2. If cover plates 680 are fitted, undo hexagon head bolts 901.2 and remove the cover plates.

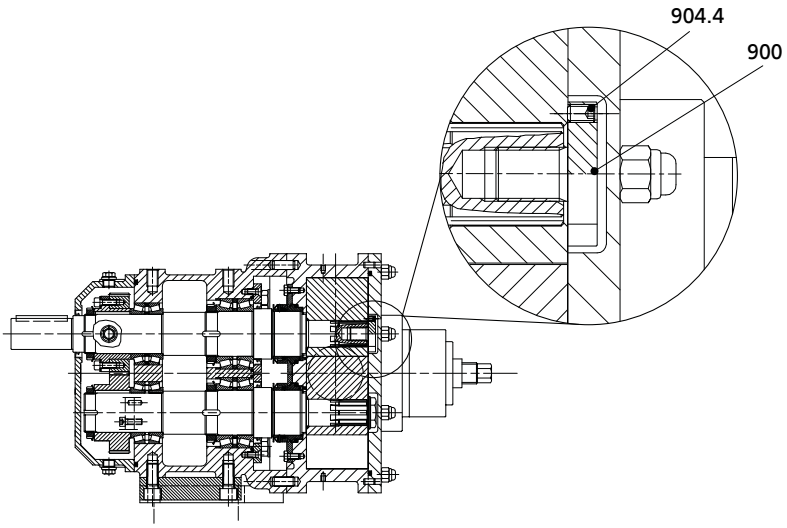
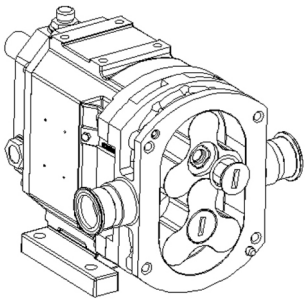


Fig. 20: Rotor screw locking system (on pumps with ATEX certification only)

3. Remove and store grub screws 904.4.



4. Undo rotor screws 900.
   ⇨ To do so, block rotors 123-15 with a non-metallic object.
5. Remove O-rings 412.1.

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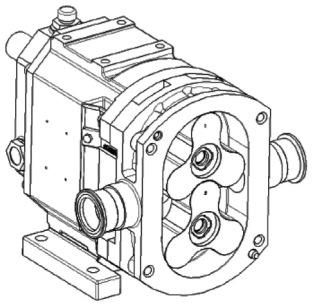
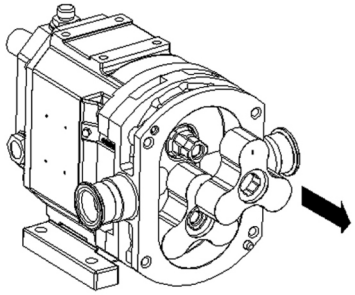
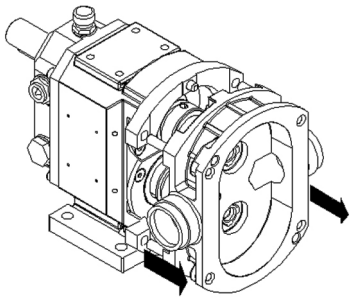


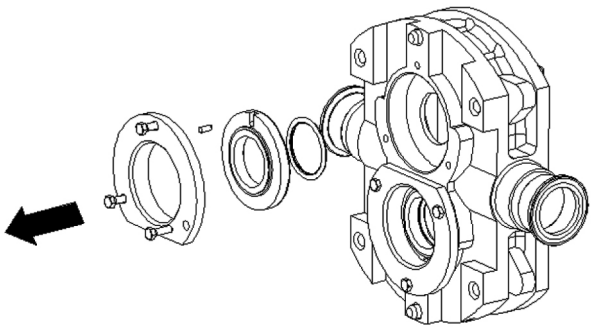
6. Mark rotors 123-15 and drive shafts 213.1/213.2.



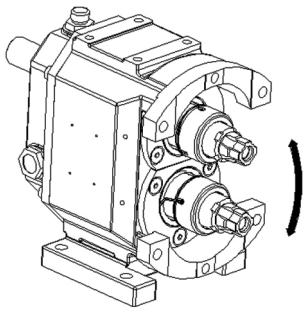
7. Remove rotors 123-15.



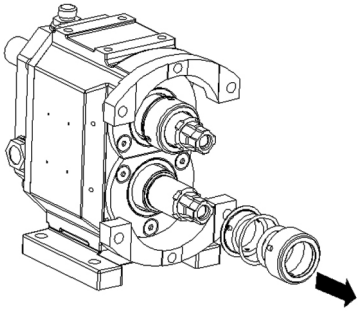
8. Undo nuts 920.3. Pull off rotor casing 100.



9. Undo hexagon head bolt 901.1. Take off seal cover 471.1. Remove the mating rings of the mechanical seals from rotor casing 100.



10. Undo the grub screws of mechanical seals 433.



11. Take the primary rings of mechanical seals 433 off shafts 213.1/213.2.

	**CAUTION** **Damage to seal faces and O-rings** Damage to the mechanical seal! ▹ Always handle the mechanical seal with utmost care.

7.5.4.3 Vitalobe sizes 550 to 680

NOTE! Dismantle the (wetted) pump head for size 550 as described for size 490 (⇨ Section 7.5.4.2, Page 62) .

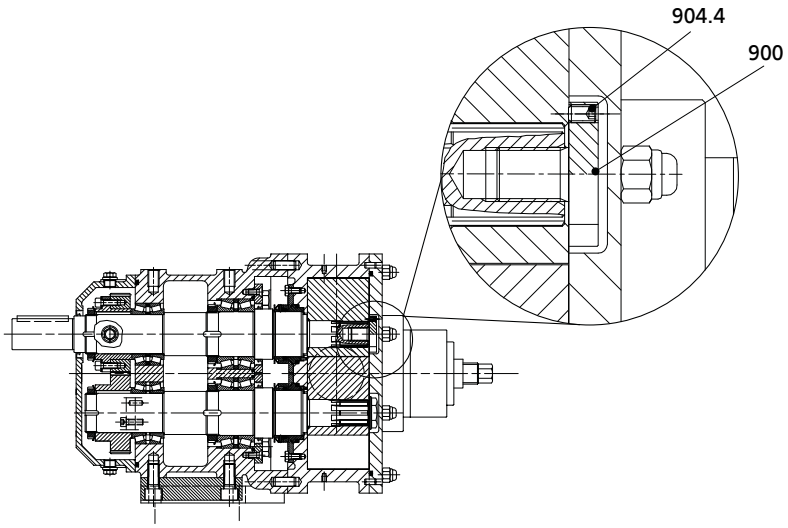


Fig. 21: Rotor screw locking system (on pumps with ATEX certification only)

1. Remove and store grub screws 904.4.

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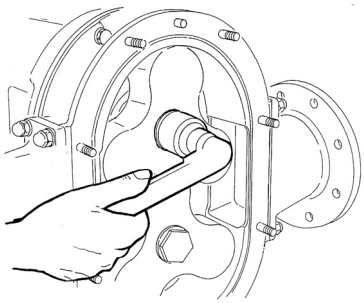
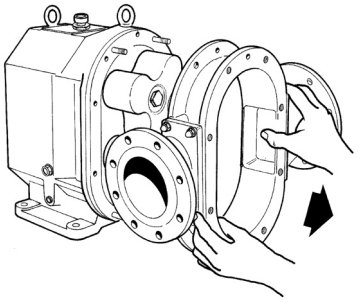
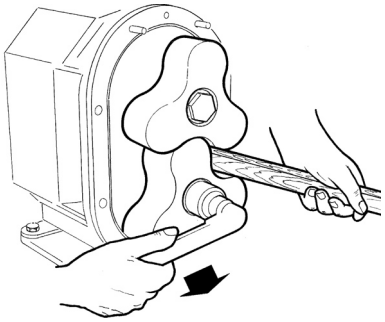


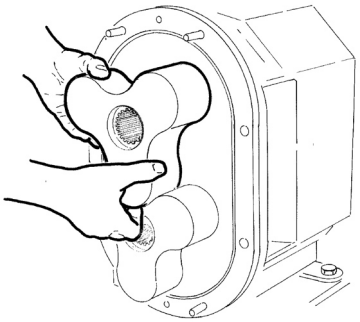
2. Remove nuts 920.1. Take off casing cover 161 with O-ring 412.2.
3. Loosen rotor screws 900.
   ⇨ To do so, block rotors 123-15 with a non-metallic object.



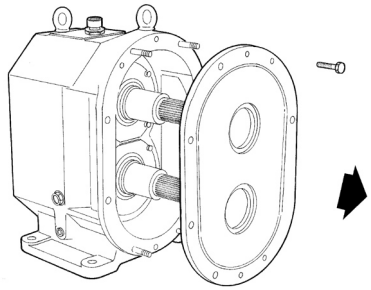
4. Undo and remove nuts 920.3 and discs 551.3. Lift rotor casing 100 off towards the front.



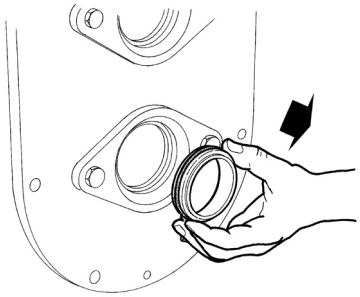
5. Remove rotor screws 900 and O-rings 412.1.
   ⇨ Mark rotors and shafts to identify their correct combination during reassembly.



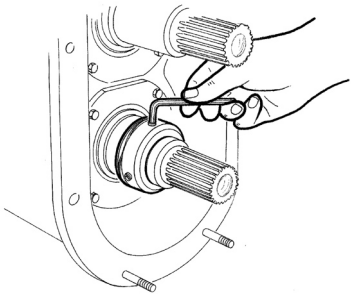
6. Gently pull rotors 123-15 off shaft 213.1/213.2. Remove O-rings 412.3.



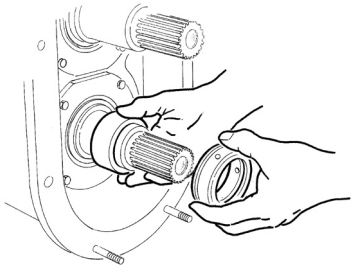
7. Undo and remove nuts 920.7 and discs 550.5. Remove O-ring 412.2. Pull off discharge cover 161.4.



8. Undo hexagon head bolts 901.8 and remove seal cover 471.1. Undo bolts 901.1 and remove the stationary seat locks.
9. Remove the mating rings of mechanical seals 433 from seal cover 471.1. Remove O-rings 412.22.



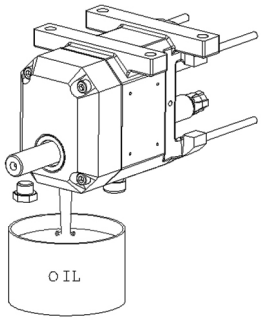
10. Undo the grub screws of mechanical seals 433.



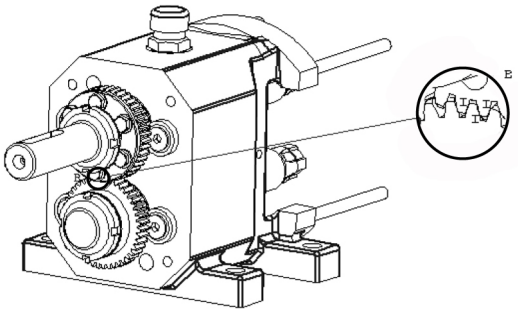
11. Pull the primary rings of mechanical seal 433 off shafts 213.1/213.2. Remove the spacer bushes.

7.5.5 Dismantling the bearing housing

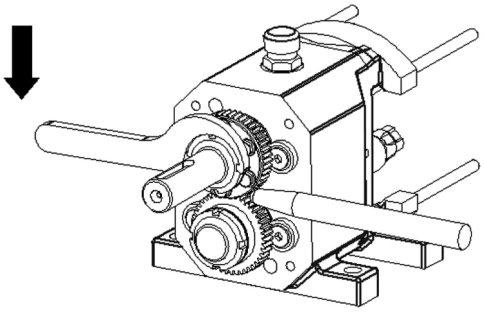
7.5.5.1 Vitalobe size 100



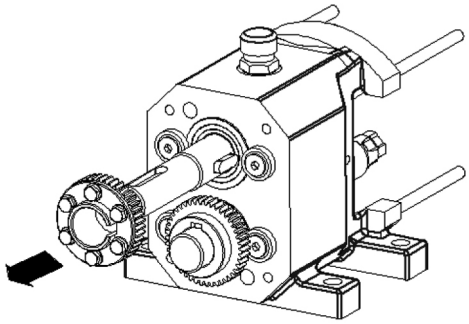
1. Remove vent plug 672. Drain the oil. (⇨ Section 7.3.3.2, Page 56)
   Remove key 940.2 from shaft 213.1.



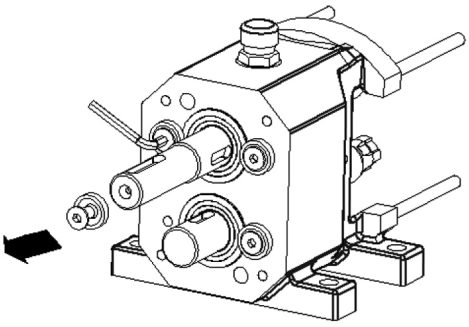
2. Undo hexagon head bolts 914.2. Remove gear housing 871 incl. O-ring 412.6 and shaft seal ring 420.1.
   Mark gear wheels 872.1, 872.2 for reference during reassembly.



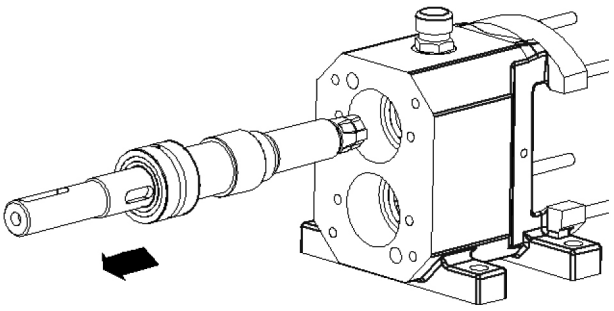
3. Undo and remove nuts 920.3. To do so, block gear wheels 872.1, 872.2 with a non-metallic object.



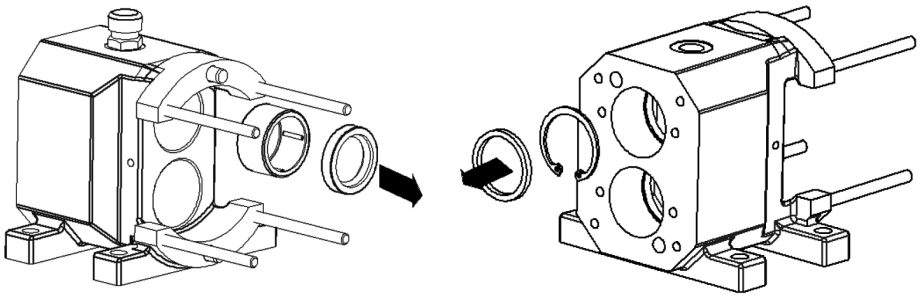
4. Undo hexagon socket head cap screws 914.1. Remove perforated disc 550.1.
   Remove gear wheels 872.1, 872.2 together with key 940.1 and bush 540.1.



5. Undo hexagon socket head cap screws 914.3. Remove spacer discs 551.3.



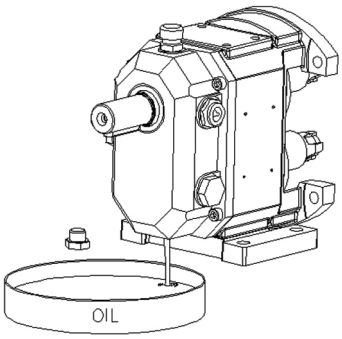
6. Pull drive shafts 213.1, 213.2 out of bearing housing 350 towards the back and take off O-ring 412.3.



7. Remove lip seals 421.2 from bearing housing 350. Remove the outer ring of front rolling element bearings 320.1.
   Remove spacer rings 504.1 and circlips 932.1.

	NOTE
	If necessary, suitable pullers can be used to pull rolling element bearings 320.1, 320.2 off shafts 213.1, 213.2.

7.5.5.2 Vitalobe sizes 105 to 490



1. Undo screw plug 903. Drain the oil. (⇨ Section 7.3.3.2, Page 56)
   Remove key 940.2 from shaft 213.1.

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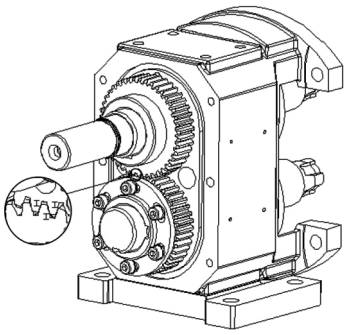
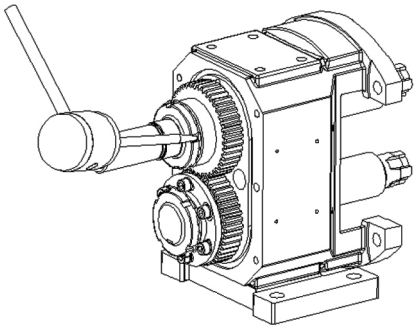
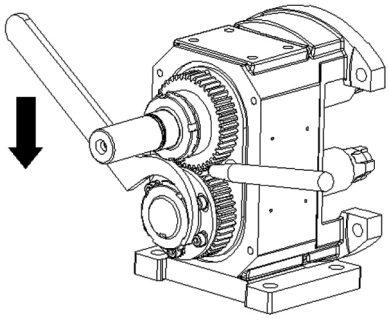


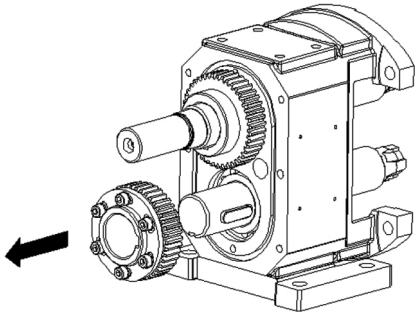
2. Undo and remove hexagon socket head cap screws 914.2. Remove gear housing 871 incl. O-ring 412.6 and lip seal 421.1.
   Mark gear wheels 872.1, 872.2 for reference during reassembly.



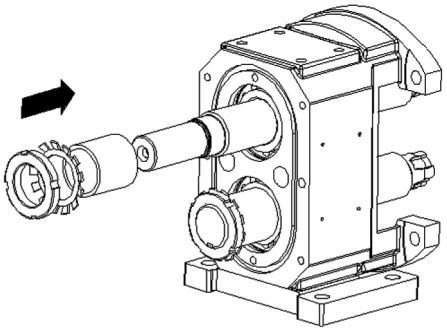
3. Undo lock washers 931.1.



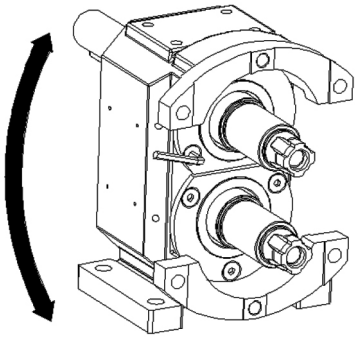
4. Block gear wheels 872.1, 872.2 with a non-metallic object. Undo and remove nuts 920.2 with lock washers 931.1.



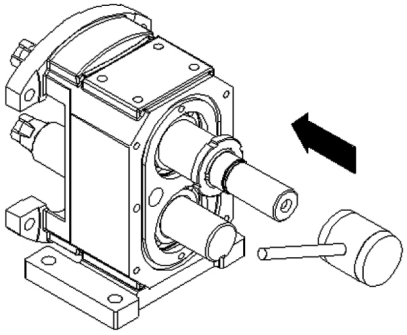
5. Undo hexagon socket head cap screws 914.1. Remove discs 550.1. Remove gear wheels 872.1, 872.2 together with key 940.1 and bush 540.1.



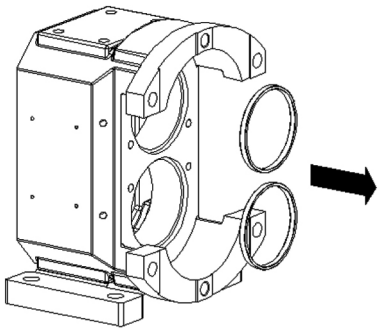
6. Replace gear wheels 872.1, 872.2 with spacer rings. Fit nuts 920.2 again.



7. Remove hexagon socket head cap screws 914.4. Remove bearing cover 360 and lip seal 421.2.



8. Pull drive shafts 213.1, 213.2 out of bearing housing 350 towards the front (use rubber mallet if necessary). Take off O-ring 412.3.



9. Remove spacer rings 504.2.

NOTE

If necessary, suitable pullers can be used to pull rolling element bearings 320.1, 320.2 off shafts 213.1, 213.2. Sizes 105, 110 and 115 are equipped with a single rolling element bearing 320.1 only.

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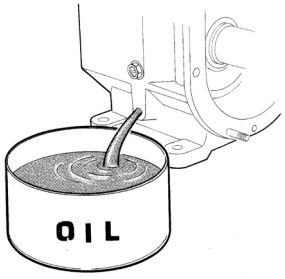
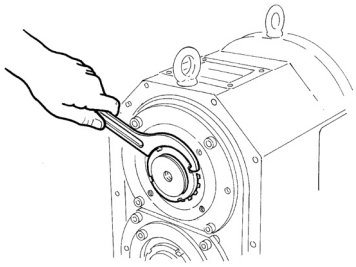
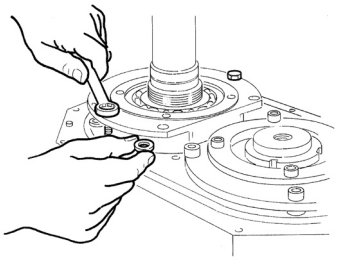
7.5.5.3 Vitalobe sizes 550 to 680



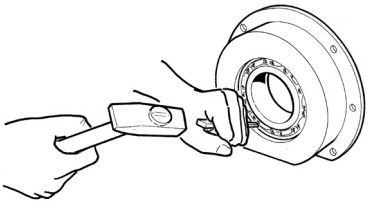
1. Remove screw plug 903. Drain the oil.



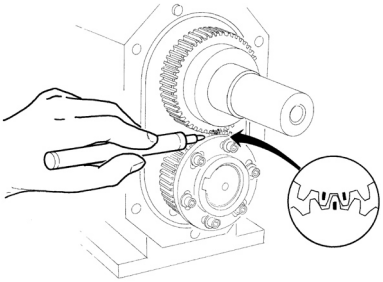
2. Remove key 940.2 from shaft 213.1. Remove hexagon socket head cap screws 914.1. Remove gear housing 871. Remove O-ring 412.6 and lip seal 421.1. Undo lock washers 931.1. Remove nuts 920.2.



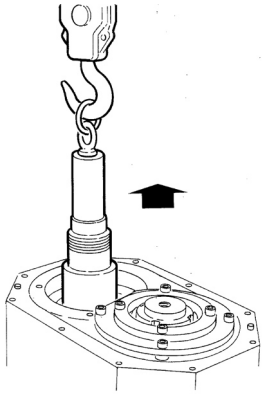
3. Place the pump in a vertical position. Undo and remove hexagon socket head cap screws 914.13. Pull off the bearing units.
   NOTE! Threaded holes are provided for the pulling-off process. Insert two screws into these threaded holes to gradually pull the bearing unit off the shaft.



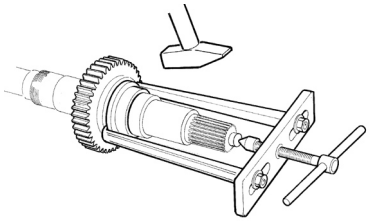
4. Undo hexagon socket head cap screws 914.12. Remove bearing bush 545. Press rolling element bearing 320.2 out of the bearing unit.



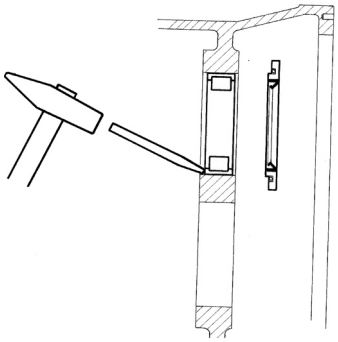
5. Mark gear wheels 872.1/872.2 to make sure they can be positioned correctly for reassembly.



6. Remove shaft units 213.1/213.2 from bearing housing 350.
   NOTE! Use lifting equipment to remove the shaft units. The threaded holes in the shaft can be used for fastening an eyebolt.



7. Pull the inner rings of rolling element bearings 320.1 off shafts 213.1/213.2. Use puller pliers to do so. Remove gear wheels 872.1/872.2 from shafts 213.1/213.2. Remove key 940.1.



8. Undo and remove hexagon socket head cap screws 914.4. Remove bearing cover 360 incl. O-rings. Remove shaft seal rings 420.2. Remove the outer rings of rolling element bearings 320.1 from bearing housing 350.

7.6 Reassembling the pump set

7.6.1 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.

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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 or exploded view.

Sealing elements Always use new O-rings.

Never use O-rings that have been made by cutting an O-ring cord to size and gluing the ends together.

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).

Coupling The flexible element of the coupling is made of natural rubber in 80 Shore hardness. It must only be replaced by flexible elements of the same specifications.

Assembly adhesives Avoid the use of assembly adhesives, if possible.

Match the lubricants to the fluid handled (e.g. water for foodstuff applications).

Tightening torques

⚠ WARNING

Insufficient tightening torque

Personal injury and damage to property!

- ▷ Always observe the tightening torques given in the following table for reassembly of the pump.

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

Table 21: Tightening torques

Size	Setting of gear wheel (914.4)		Rotor screw (900)		Cap nut of casing (920.2)		Cap nut of casing cover (920.1)		Slotted round nut of bearing (920.4)		Slotted round nut of gear wheel (920.3)	
	Bolt/screw	M [Nm]	Bolt/screw	M [Nm]	Bolt/screw	M [Nm]	Bolt/screw	M [Nm]	Bolt/screw	M [Nm]	Bolt/screw	M [Nm]
100	M4 × 0,7	3	M8 × 1	25	M6 × 1	10	M6 × 1	10	-	-	M20 × 1	50
105	M5 × 0,8	5	M12 × 1	85	M8 × 1,25	30	M8 × 1,25	30	-	-	M30 × 1,5	90
110												
115												
215	M6 × 1	10	M14 × 1,5	190	M10 × 1,5	50	M10 × 1,5	50	M40 × 1,5	105	M35 × 1,5	90
220												
325	M8 × 1,25	20	M20 × 1,5	305	M12 × 1,75	70	M10 × 1,5	50	M50 × 1,5	115	M40 × 1,5	105
330												
390												
430	M10 × 1,25	50	M24 × 2	480	M16 × 2	115	M12 × 1,75	70	M70 × 2	220	M60 × 2	145
440												
470	M10 × 1,25	50	M24 × 2	480	M20 × 2,5	180	M14 × 2	95	M80 × 2	400	M70 × 2	220
490												
550	M12 × 1,75	70	M24 × 2	500	M14 × 2	115	M12 × 1,75	70	-	-	M70 × 2	220
660	M16 × 2	170	M36 × 2	600	M14 × 2	115	M14 × 2	70	-	-	M100 × 2	600
680												

7.6.2 Adjusting the clearances

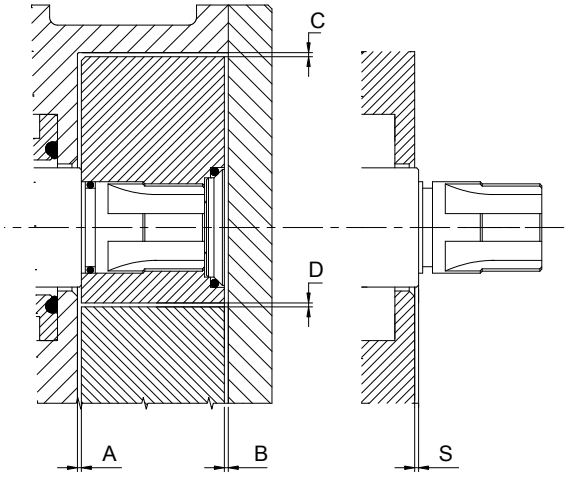

Fig. 22: Pump clearances

A	Behind rotor, distance between rotor and rear casing wall	B	In front of rotor, distance between rotor and casing cover
C	Distance between rotors and pump casing	D	Distance between rotor 1 and rotor 2

Explanation:

All distances are factory-defined and must be strictly adhered to.

Table 22: Clearances [mm]

Size	Rotary lobes 316L ST - standard clearances				Rotary lobes 316L SM - increased clearances				Rotary lobes Stainless steel sliding alloy, standard clearances				Shaft projection
	A	B	C	D	A	B	C	D	A	B	C	D	S
100	0,12	0,12	0,15	0,2	0,15	0,15	0,2	0,2	0,07	0,08	0,19	0,15	0,12
105	0,12	0,15	0,15	0,25	0,17	0,19	0,2	0,3	0,05	0,05	0,13	0,15	0,12
110	0,14	0,14	0,15	0,3	0,19	0,19	0,23	0,3	0,08	0,07	0,15	0,2	0,14
115	0,14	0,14	0,18	0,3	0,19	0,19	0,22	0,3	0,07	0,08	0,2	0,2	0,14
215	0,15	0,15	0,18	0,3	0,22	0,23	0,3	0,3	0,08	0,07	0,18	0,2	0,15
220	0,15	0,17	0,23	0,3	0,25	0,25	0,32	0,3	0,08	0,07	0,2	0,2	0,15
325	0,17	0,17	0,2	0,35	0,25	0,25	0,32	0,35	0,08	0,08	0,2	0,2	0,17
330	0,17	0,19	0,23	0,35	0,27	0,28	0,32	0,35	0,09	0,08	0,23	0,2	0,17
430	0,18	0,18	0,22	0,35	0,27	0,27	0,32	0,35	0,09	0,08	0,23	0,2	0,18
440	0,18	0,18	0,22	0,35	0,27	0,27	0,32	0,35	0,1	0,1	0,25	0,2	0,18
470	0,2	0,2	0,27	0,35	0,32	0,32	0,35	0,35	0,09	0,09	0,25	0,2	0,2
490	0,23	0,23	0,3	0,35	0,35	0,35	0,35	0,45	0,09	0,09	0,25	0,2	0,23
550	0,22	0,22	0,3	0,4	0,32	0,32	0,43	0,4	0,15	0,15	0,35	0,25	0,22
660	0,27	0,27	0,35	0,5	0,37	0,37	0,5	0,5	-	-	-	-	0,27
680	0,3	0,35	0,35	0,5	0,37	0,37	0,5	0,5	-	-	-	-	0,27

The clearances must always be set in accordance with the rotor type and operating pressure used.

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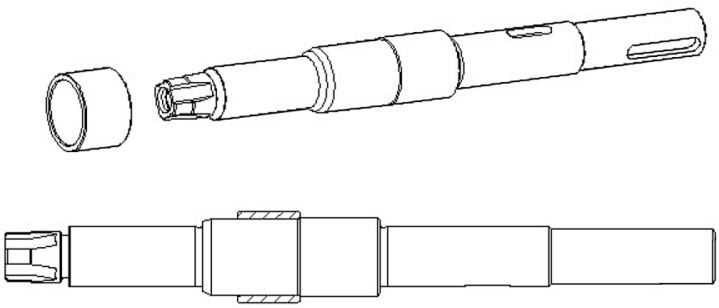
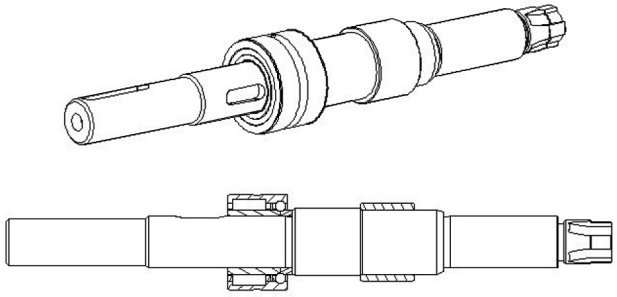
7.6.3 Fitting the bearing housing

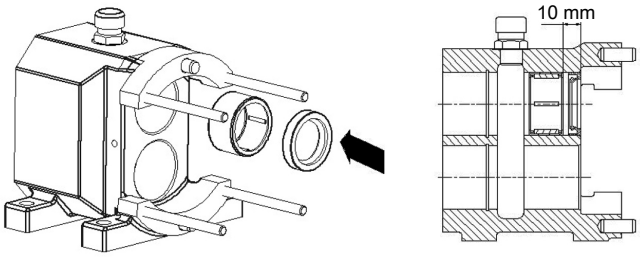
7.6.3.1 Vitalobe size 100



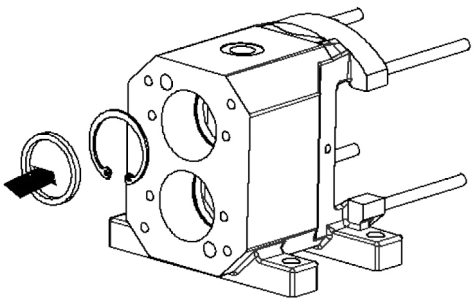
1. Thoroughly clean drive shafts 213.1, 213.2. Check shafts 213.1/213.2 and rolling element bearings 320.1/320.2 for any damage. Pull the inner ring of front rolling element bearing 320.1 onto shaft 213.1. Repeat the same procedure on the second shaft 213.2.



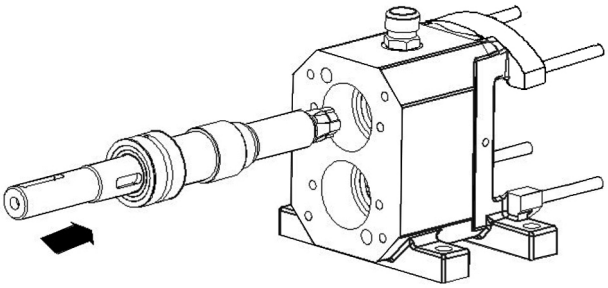
2. Fit rear rolling element bearing 320.2 on shaft 213.1. Repeat the same procedure on the second shaft 213.2. Insert O-rings 412.3 in the area of the rotor seat at the shaft shoulder at shafts 213.1/213.2 respectively.



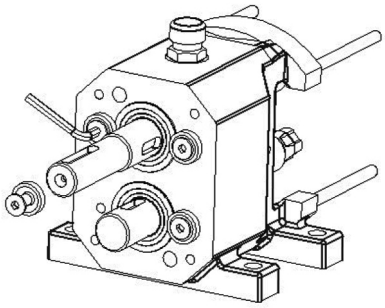
3. Press the outer rings of front rolling element bearings 320.1 into bearing housing 350, strictly observing the dimension of 10 mm.



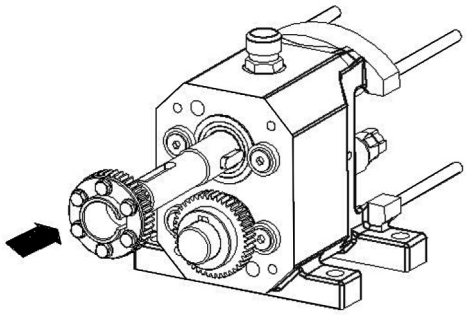
4. Fit circlip 932.1 and spacer ring 504.1 in bearing housing 350.



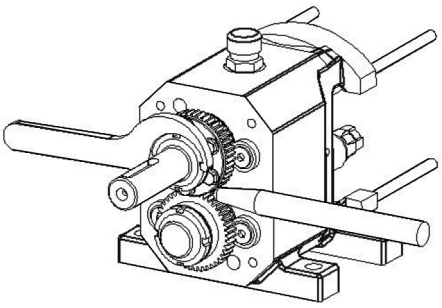
5. Slide shafts 213.1 and 213.2 into bearing housing 350 from the rear end.



6. Fasten rolling element bearings 320.1/320.2 to bearing housing 350 using spacer discs 551.3 and hexagon socket head cap screws 914.3.



7. Fit fixed gear wheel 872.1 including key 940.1 on shaft 213.2. Fit adjustable gear wheel 872.2 with bush 540.1 on shaft 213.2. Place disc 550.1 on adjustable gear wheel 872.2. Loosely screw in hexagon socket head cap screws 914.1.



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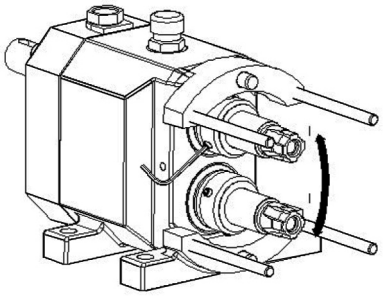
8. Fit and tighten nuts 920.2 on shafts 213.1/ 213.2.
   To do so, block the gear wheels with an object made of soft material (e.g. wood).



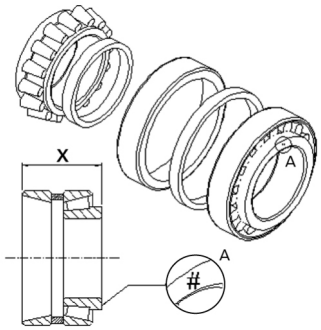
9. Fit lip seals 421.1 and 421.2.

7.6.3.2 Vitalobe sizes 105 to 490

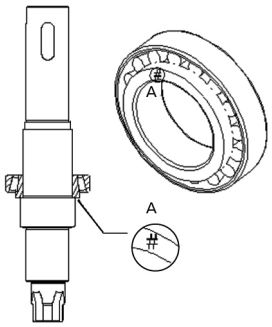
Fitting the front rolling element bearing on both drive shafts

Table 23: Bearing dimensions [mm]

Size	Dimension X
105, 110, 115	63,0
215, 220	39,5
325, 330, 390	41,4
430, 440	50,9
470, 490	66,0



1. Verify dimension "X". Tolerance of the dimension: +/- 0.02 mm.



2. Heat up the inner rings of rolling element bearings 320.1 marked # to approx. 150 °C. Fit one on each shaft 213.1/213.2.

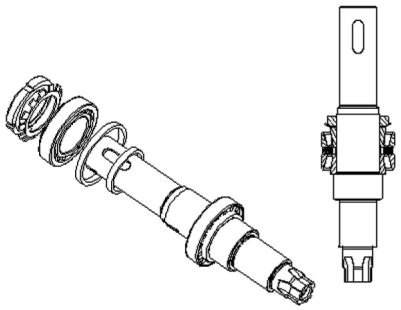
⚠ WARNING

Hot components

Fire hazard!

Risk of injury!

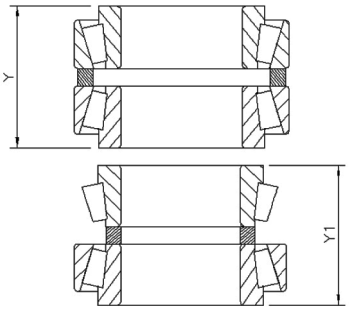
▷ Always wear gloves. After reassembly of the bearings allow all parts to cool down to room temperature.



3. Fit rolling element bearings 320.1. Grind (lap) the inner spacer ring to the correct width (dimension X).
   The rolling element bearings should be pre-loaded by 0.05 mm. Fit a rolling element bearing on each shaft 213.1/213.2.
4. Fasten rolling element bearings 320.1 using a nut 920.4 and lock washer 931.2 each.

Fitting the rear rolling element bearings on both drive shafts

Sizes 105, 110 and 115 feature a (front) rolling element bearing only.



1. Determine dimensions "Y" and "Y1" of rolling element bearings 320.2.
   Determine dimension "Y" without the inner spacer ring.
   Determine dimension "Y1" “without the outer spacer ring and without the outer ring of the rolling element bearing.
   ⇨ “Y1" must be 0.05 mm smaller than "Y": Y1 = Y - 0.05 mm

NOTE

Perform the following step for sizes 215 to 490 only.

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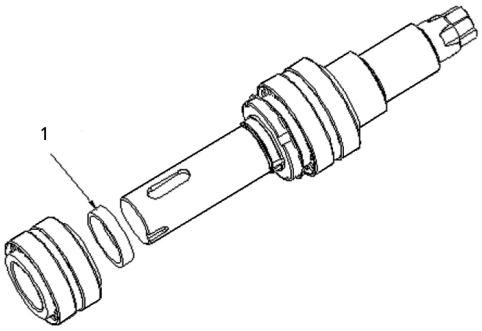


1	Spacer ring required for sizes 215 to 490 only

2. Slide a spacer ring 504.3 on each shaft 213.1, 213.2.

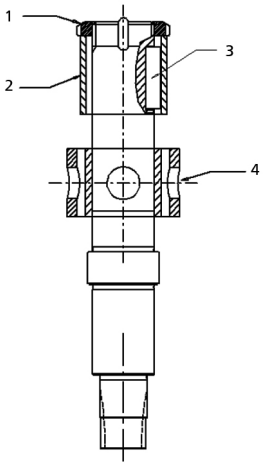


Fig. 23: For sizes 105 to 115

1	Nut	2	Spacer sleeve
3	Key	4	Bearing housing, assembled

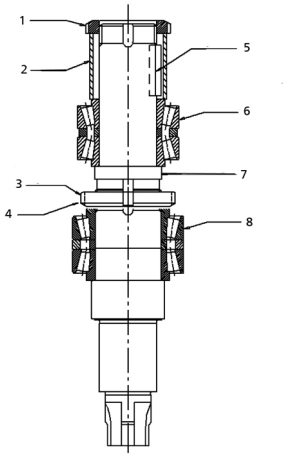
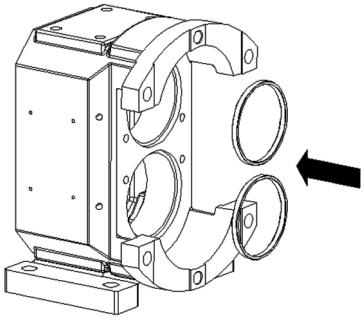


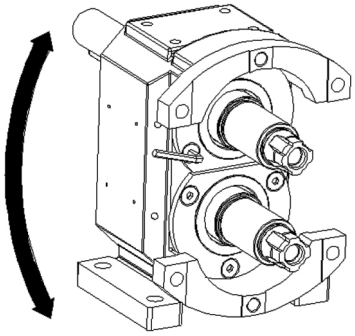
Fig. 24: For sizes 215 to 490

1	Rear nut	2	Spacer sleeve
3	Front nut	4	Washer
5	Key	6	Rear rolling element bearing, pre-assembled
7	Bearing spacer ring (for sizes 215, 220 only)	8	Front rolling element bearing, pre-assembled

3. Fit a pre-assembled rolling element bearing 320.2 on each shaft 213.1/213.2. Fasten them each with nut 920.2 and lock washer 931.1, fitting a spacer sleeve instead of the gear wheels.

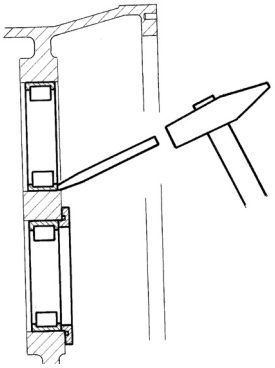


4. Fit spacer rings 504.1 in bearing housing 350. Then fit both shafts 213.1/213.2 in bearing housing 350 and place O-rings 412.3 on the shafts.

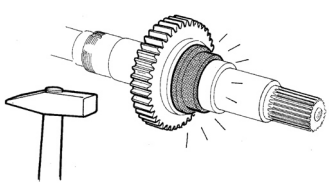


5. Place O-rings 412.7 on bearing cover 360. Fit lip seals 421.2 on shafts 213.1/213.2. Fasten bearing cover 360 on bearing housing 350 with hexagon socket head cap screws 914.4.

7.6.3.3 Vitalobe sizes 550 to 680



1. Insert the outer rings of rolling element bearings 320.1 into bearing housing 350. Make sure that they are axially aligned as the bearing does not rest on a shoulder.



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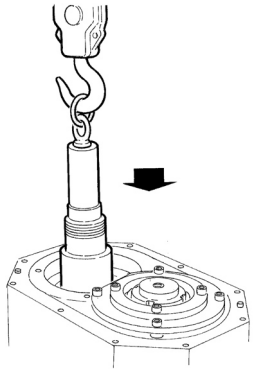
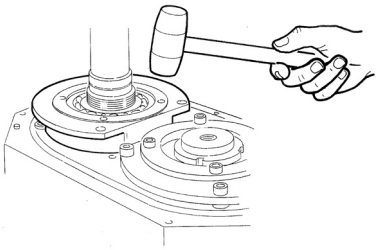
	**⚠ WARNING** **Hot components** Fire hazard! Risk of injury! ▷ Always wear gloves. After reassembly of the bearings allow all parts to cool down to room temperature.

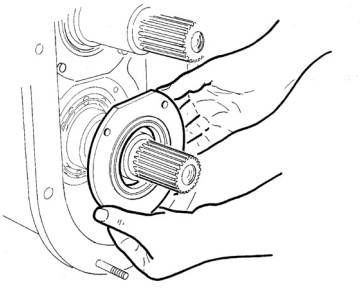
2. Pull the inner rings of rolling element bearings 320.1 onto shafts 213.1/213.2. To do so, heat up the inner ring to approx. 90 °C in an oil bath. Slide it onto shafts 213.1/213.2.
   Insert key 940.1 in shaft 213.2. Place gear wheels 872.1/872.2 onto shafts 213.1/213.2. Use a mallet for this process.
   Important: Fit adjustable gear wheel 872.2 on the driven shaft 213.2 which is not connected with the coupling.



3. Fit shafts 213.1/213.2 in bearing housing 350. Use the markings on the gear wheels as a reference.



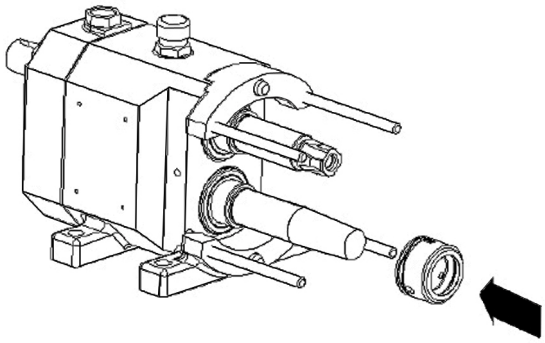
4. Slide spacer rings 504.3 onto shafts 213.1/213.2. Fit the bearing units. To do so, press rolling element bearing 320.2 into the bearing seat and fasten bearing bearing bush 545 with hexagon socket head cap screws 914.12. Pull the bearing unit onto shafts 213.1/213.2. Insert spacer rings 504.1. Fasten the bearing unit to bearing housing 350 with hexagon socket head cap screws 914.13.



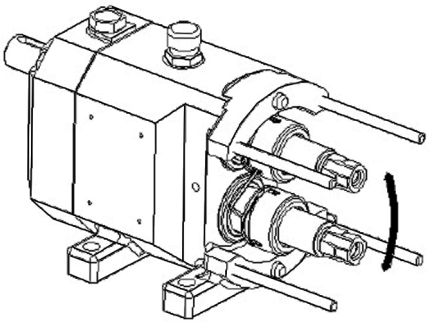
5. Place O-rings on bearing cover 360. Fasten the bearing cover to bearing housing 350 with hexagon socket head cap screws 914.4. Fit lip seals 421.2.

7.6.4 Installing the rotor casing

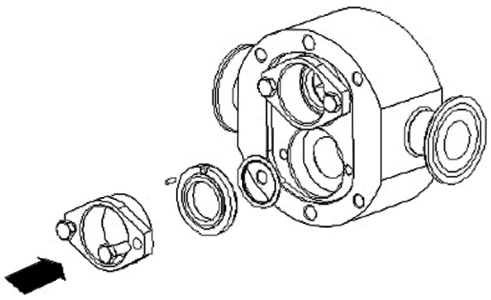
7.6.4.1 Vitalobe size 100



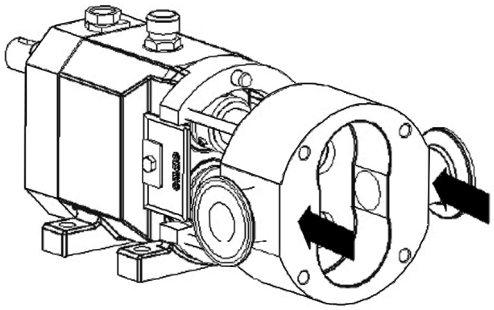
1. Thoroughly clean shafts 213.1/213.2. Slide the primary rings of mechanical seals 433 onto shafts 213.1/213.2. If necessary, apply lubricant to mechanical seals 433 for reassembly.



2. Make sure that the primary rings of mechanical seals 433 rest against the shaft shoulder. Evenly tighten the grub screws of mechanical seals 433.



3. Place the mating rings of mechanical seals 433 into rotor casing 100. Make sure that parallel pin 562.1, which serves as anti-rotation device, is correctly seated. Fit seal cover 471.2 and fasten it with hexagon head bolts 901.1.



4. Thoroughly clean the seal faces of mechanical seals 433. Insert parallel pins 562.2 in rotor casing 100. Place the rotor casing on bearing housing 350. Tighten nuts 920.3.

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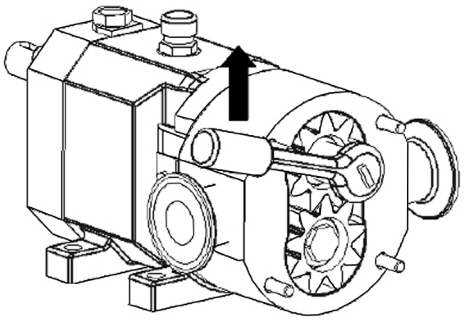


5. Fit rotors 123-15 and fasten with rotor screws 900 including O-rings 412.1. Observe the correct clearances. (⇨ Section 7.6.2, Page 74)
   ⇨ To do so, block rotors 123-15 with a non-metallic object.

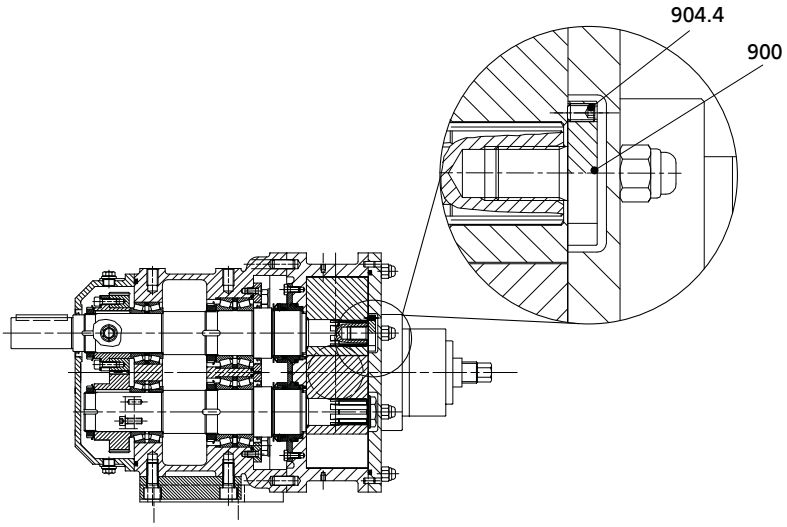
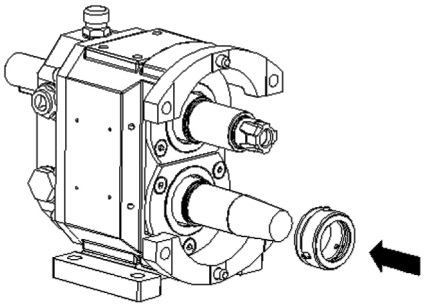


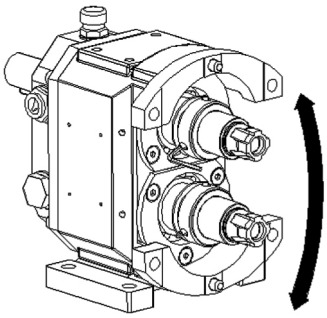
Fig. 25: Rotor screw locking system (on pumps with ATEX certification only)

6. Insert and tighten grub screws 904.4.

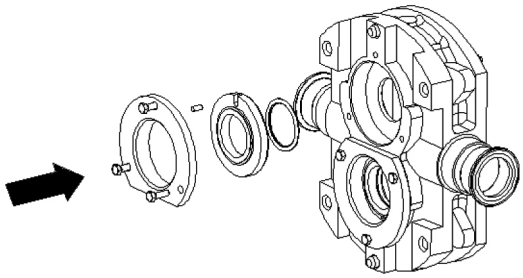
7.6.4.2 Vitalobe sizes 105 to 490



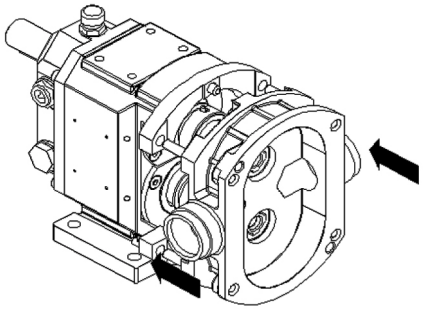
1. Thoroughly clean shafts 213.1/213.2. Slide the primary rings of mechanical seals 433 onto shafts 213.1/213.2.
2. If necessary, apply lubricant to mechanical seals 433 for reassembly.



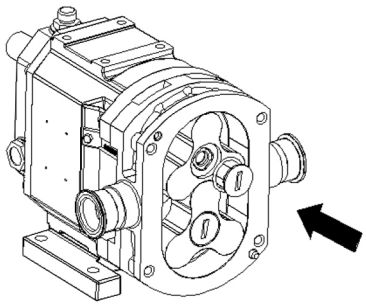
3. Make sure that the primary rings of mechanical seals 433 rest against the shaft shoulder. Evenly tighten the grub screws of mechanical seals 433.



4. Place the mating rings of mechanical seals 433 into rotor casing 100.
   ⇨ Make sure that parallel pin 562.1, which serves as anti-rotation device, is correctly seated.
5. Fit seal cover 471.1 and fasten it with hexagon head bolts 901.1.



6. Thoroughly clean the seal faces of mechanical seals 433.
7. Insert parallel pins 562.2 and grub screws 904.1 and 904.2 in rotor casing 100. Place the rotor casing on bearing housing 350.
8. Fit nuts 920.3 together with spacer discs 551.3. Tighten the nuts.



9. Fit rotors 123-15 and fasten with rotor screws 900 including O-rings 412.1. Observe the correct clearances. (⇨ Section 7.6.2, Page 74)
   ⇨ To do so, block rotors 123-15 with a non-metallic object.

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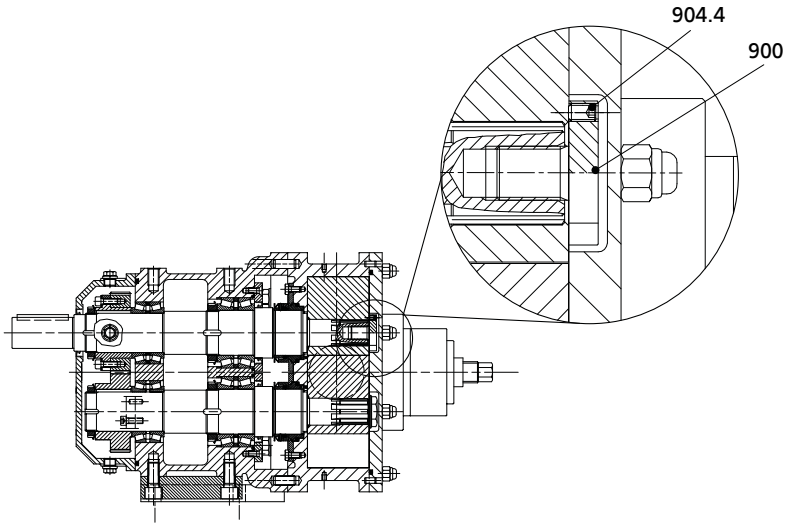
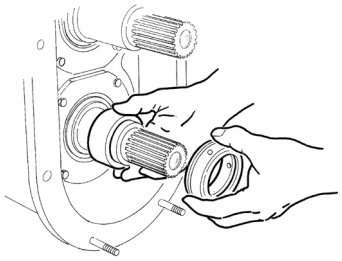


Fig. 26: Rotor screw locking system (on pumps with ATEX certification only)

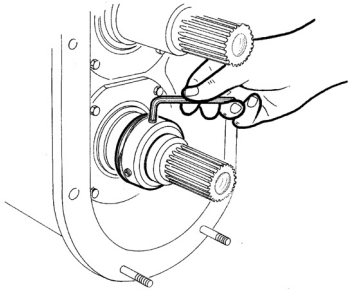
10. Insert and tighten grub screws 904.4.

7.6.4.3 Vitalobe sizes 550 to 680

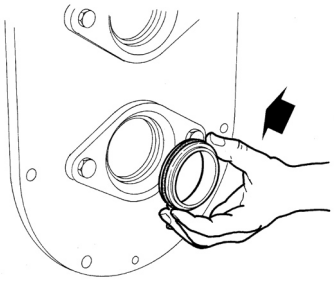
NOTE! Reassemble pump size 550 as described for size 490 (⇨ Section 7.6.4.2, Page 83) .



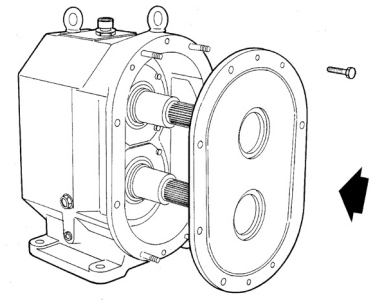
1. Check that shafts 213.1/213.2 are clean. If necessary, gently clean them. Slide the spacer bushes onto the shafts. Place the primary rings of mechanical seals 433 on shafts 213.1/213.2.



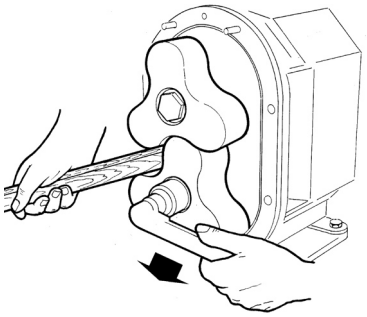
2. Slide the primary rings of mechanical seals 433 against the spacer bushes. Fasten them with a grub screw.
3. Place O-rings 412.3 on shafts 213.1/213.2.



4. Insert mating rings of mechanical seals 433 into seal cover 471.1. Fasten the stationary seat lock with bolts 901.1.
5. Pull O-ring 412.22 onto seal cover 471.1.
6. Fasten seal cover 471.1 to casing cover 161.4 with bolts 901.8.



7. Insert parallel pin 562.2 and studs 902.1 in bearing housing 350.
8. Fasten casing cover 161.4 at bearing housing 350.



9. Place rotors 123-15 onto shafts 213.1/213.2.
10. Fit O-rings 412.1 on rotor screws 900. Use these screws to fasten rotors 123-15 to shafts 213.1/213.2.
    ⇨ To do so, block rotors 123-15 with a non-metallic object.
11. Observe the tightening torques! (⇨ Section 7.6.1, Page 72)

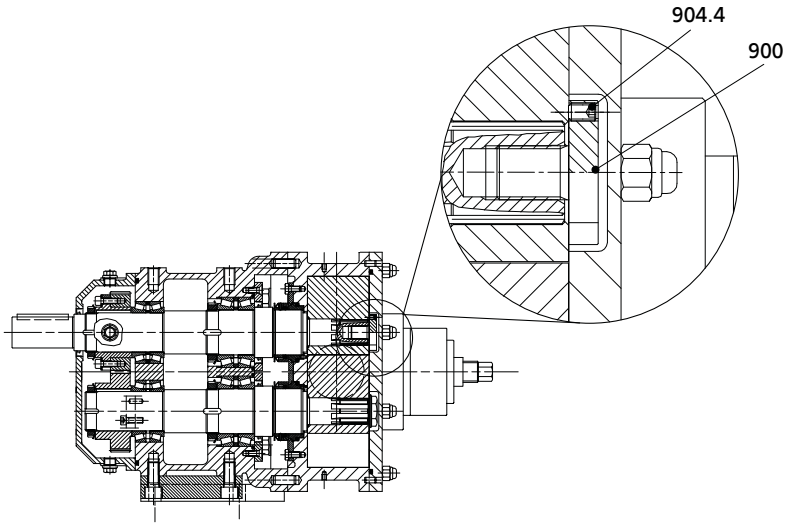


Fig. 27: Rotor screw locking system (on pumps with ATEX certification only)

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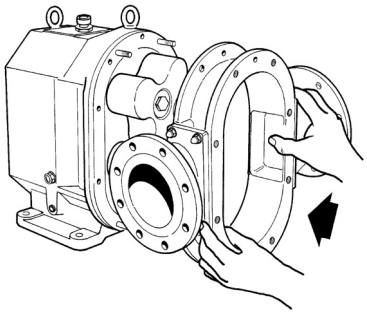
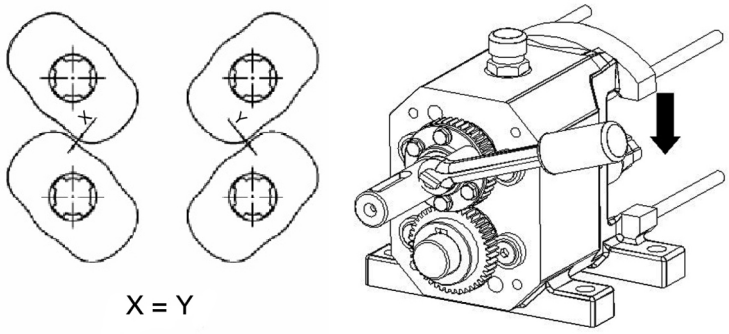
12. Insert and tighten grub screws 904.4.



13. Fit O-ring 412.2 on casing cover 161.4. Fasten the casing cover to casing 100 with studs 902.1, discs 550.5 and nuts 920.7.

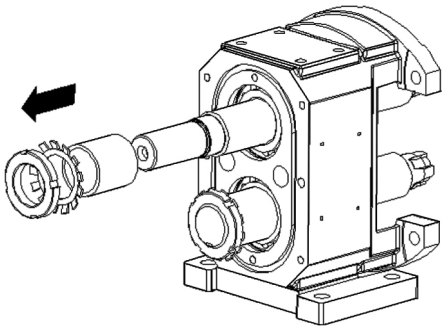
7.6.5 Adjusting the rotor clearances and completing the assembly

7.6.5.1 Vitalobe size 100

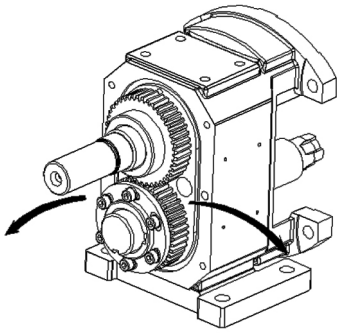


1. Accurately align rotors 123-15 (⇨ Section 7.6.2, Page 74) and evenly tighten hexagon socket head cap screws 914.1 of adjustable gear wheel 872.2 in several increments.
2. Place O-ring 412.6 on gear housing 871. Fasten the gear housing to bearing housing 350 using hexagon socket head cap screws 914.2.
3. Insert lip seal 421.1 into gear housing 871. Fit screw plugs 903. Insert key 940.2 in shaft 213.1.
4. Fasten cover plates 680, if any, on bearing housing 350 with hexagon head bolts 901.2.
5. Fit O-ring 412.2 on casing cover 161. Fasten the casing cover to rotor casing 100 with cap nuts 920.1.
6. Remove screw plug 672. Fill in the oil. Observe the oil quantity indicated in (⇨ Section 7.3.3.2.3, Page 56)
7. Re-insert and tighten screw plug 672.

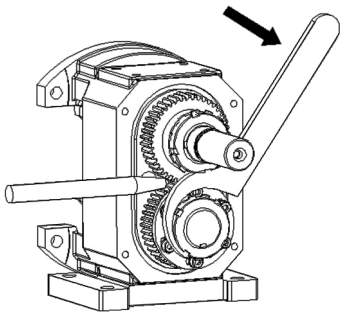
7.6.5.2 Vitalobe sizes 105 to 490



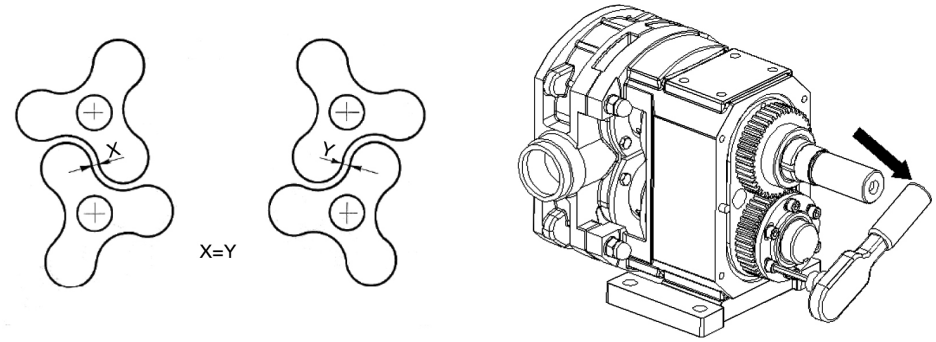
1. Remove the spacers used for bearing reassembly. To do so, remove nut 920.2 and lock washer 931.1.



2. Fit gear wheel 872.1 on shaft 213.1. Assemble adjustable gear wheel 872.2 with bush 540.1. Slide this assembly onto shaft 213.2. Fit hexagon socket head cap screws 914.1 with discs 550.1. Screw them lightly into bush 540.1 and gear wheel 872.2.



3. Fit lock washers 931.1 and nuts 920.2 on each shaft 213.1/213.2. Fasten the lock washers. Tighten the nuts. To do so, block the gear wheels with an object made of soft material (e.g. wood).



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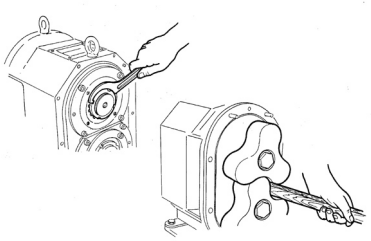
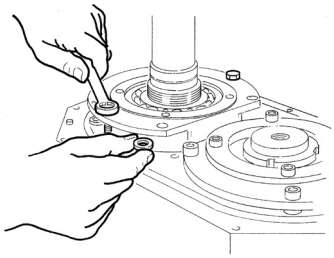
4. Accurately align the rotors (⇨ Section 7.6.2, Page 74) and evenly tighten hexagon socket head cap screws 914.1 of adjustable gear wheel 872.2 in several increments.

5. Place O-ring 412.6 on gear housing 871. Fasten the gear housing to bearing housing 350 using hexagon socket head cap screws 914.2.
6. Insert lip seal 421.1 into gear housing 871. Fit screw plugs 903. Place key 940.2 in shaft 213.1. Mount oil level sight glass 626 on gear housing 871.
7. Fasten cover plates 680, if any, on bearing housing 350 with hexagon head bolts 901.2.
8. Fit O-ring 412.2 on casing cover 161. Fasten the casing cover to rotor casing 100 with nuts 920.1.
9. Remove screw plug 672. Fill in the oil. Observe the oil quantity indicated in (⇨ Section 7.3.3.2.3, Page 56)
10. Re-insert and tighten screw plug 672.

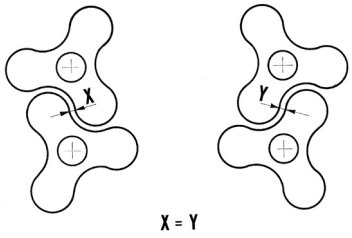
7.6.5.3 Vitalobe sizes 550 to 680

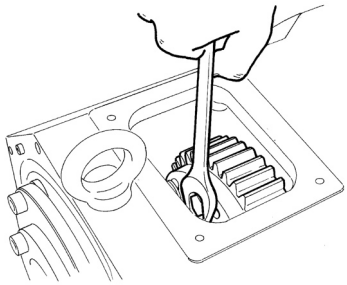


1. Place lock washers 931.1 on shafts 213.1/213.2. Tighten nuts 920.2. To do so, block the rotors with a non-metallic object.



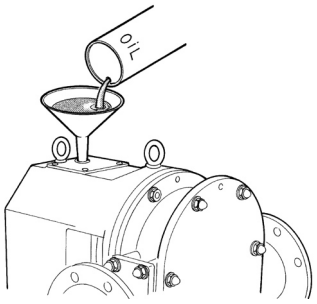
2. Adjust the axial clearance of rotors 123-15. To do so, undo hexagon socket head cap screws 914.13 and adjust spacer rings 504.1 accordingly.





3. Adjust the rotor clearance. To do so, loosen adjustable gear wheel 872.2 at hexagon socket head cap screws 914.1. Adjust the clearance and tighten hexagon socket head cap screws 914.1. Observe the tightening torques. (⇨ Section 7.6.1, Page 72)

⇨ The adjustable gear wheel can be accessed through an opening in the bearing housing. To do so, undo and remove screws 900.6 and take off cover 160.3. After adjusting the rotor clearance, fasten cover 160.3 again with screws 900.6.



4. Undo hexagon socket head cap screws 914.2. Fit O-ring 412.6 in gear housing 871. Fasten the gear housing with hexagon socket head cap screws 914.2.
5. Fit lip seal 421.1. Insert key 940.2 in shaft 213.1. Fit the casing cover with O-ring 412.2. Fasten the casing cover to casing 100 with nuts 920.1 and discs 550.3. Observe the tightening torques. (⇨ Section 7.6.1, Page 72)
6. Remove screw plug 672. Fill in the oil. Observe the oil quantity indicated in (⇨ Section 7.3.3.2.3, Page 56)
7. Re-insert and tighten screw plug 672.

7.6.5.4 Completing the assembly

1. Place the pump and drive on the baseplate using suitable lifting equipment.
2. Thoroughly clean shaft ends and coupling parts. Remove any nicks or burrs from the shafts.

⚠ WARNING

Hazard caused by improper use of solvent

Personal injury and damage to machinery

▹ Observe the manufacturer's instructions for handling solvents.

3. Fit the flange on the pump-side shaft without tightening it.
4. Fit the flange on the drive-end shaft without tightening it.

⚠ WARNING

Lack of care when moving pump and drive towards each other

Risk of crushing hands!

▹ Take care when moving pump and drive towards each other.

5. Move the pump and drive towards each other. We recommend positioning the shaft ends observing the distance S, see "Radial displacement" table. (⇨ Table 24) The shaft end must not protrude from inner surface of the hub. Tighten the flange on the pump-side shaft as indicated in the "Tightening torques" table. (⇨ Section 7.6.5.5, Page 92)

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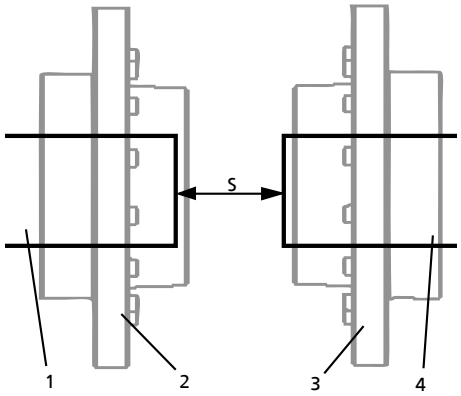

Fig. 28: Distance between shaft ends

S	Distance between shaft ends	1	Pump shaft
2	Pump flange	3	Drive shaft
4	Drive flange		

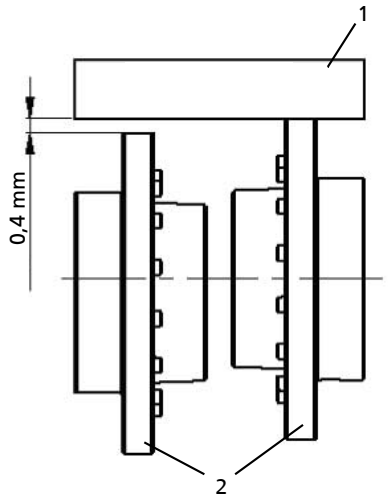

Fig. 29: Radial misalignment

1	Straight-edge	2	Flange

6. Check the parallel alignment of the shafts by placing a straight-edge across the flanges at several places and using a feeler gauge.

NOTE

The deviation must not exceed 0.4 mm.

7. Move the loose flange to install the flexible element. Fasten the element (with the ring) on the pins in the mounted flange. Slide the loose flange into position making sure the flange pins are properly engaged in the flexible element. Position the flanges observing dimension “C” shown in the "Radial misalignment" table. (⇨ Table 24) . Tighten the flange as indicated in the "Tightening torques" table. (⇨ Section 7.6.5.5, Page 92)

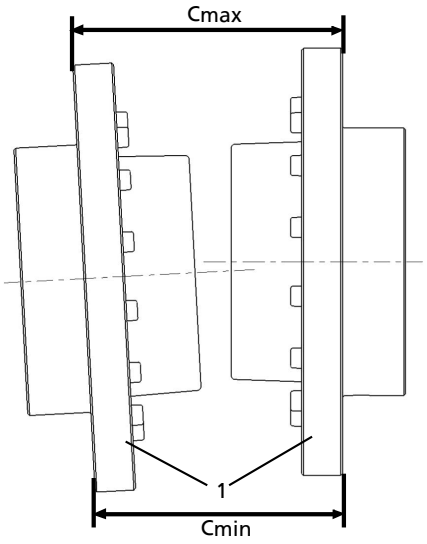

Fig. 30: Angular alignment

1	Flange	C_{min}	Minimum distance
C_{max}	Maximum distance		

8. Check the angular alignment by measuring the distance between the flanges with sliding calipers. Perform this measurement at several points of the coupling to determine the value X for the minimum distance C_{min} and maximum distance C_{max}.

NOTE

The difference between the values C_{min} and C_{max} must not exceed the value X in the "Radial misalignment" table (⇨ Table 24) .
$X = C_{max} - C_{min}$
This value should be close to 0. If the difference is greater than value “X”, re-align the shafts.

Table 24: Radial misalignment

Coupling design	Distance [mm]		
	C	X	S
SF3	67	1,5	6
SF4	77	2	8
SF5	92	2	8
SF6	102	3	12
SF7	123	3	15

9. Fit the coupling guard to the base plate.

7.6.5.5 Tightening torques

NOTE

Tightening torques apply to screws/bolts with untreated surfaces which are not or only lightly oiled (friction coefficient μ = 0.14). The use of lubricant paint or similar substances which affect the friction coefficient is impermissible.

NOTE

Apply thread-locking agent Loctite 243 to the hexagon socket head cap screws.

Table 25: Tightening torques

Design	Tightening torque M_A and width across flats C_W for hexagon socket head cap screws	
	M_A [Nm]	C_W [mm]
SF3	32	M8
SF4	32	M8
SF5	40	M10
SF6	40	M10
SF7	50	M12

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
- Consecutive number
- Type series
- Size
- Material variant
- Seal code
- Year of construction

Refer to the name plate for all data. (⇨ Section 4.4, Page 19)

Also specify the following data:

- Part number and description
- 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 26: Spare parts stock

Kits	Part No.	Description	1	2	3	4 and more
-	123-15	Rotor set	1	1	1	30%
-	320.1 + 320.2	Rolling element bearing set	1	1	1	25%
Kit of sealing elements for bearing bracket / gear unit	421.1	Shaft seal ring for gear housing	2	3	4	100%
	421.2	Shaft seal ring set for bearing bracket	2	3	4	100%
	412.6	O-ring for gear housing	1	2	3	100%
Kit of sealing elements for mechanical seal with flushing system	421.3	Shaft seal ring set for mechanical seal with flushing system	-	-	-	-
	412.10	O-ring set for seal housing	1	2	3	100%
	412.11	O-ring set for bush	1	2	3	100%
-	433	Mechanical seal set	1	2	3	100%
-	421.4	Shaft seal ring for housing (set)				
Kit of sealing elements for casing	412.1	O-ring set for rotor screw	1	2	3	100%
	412.2	O-ring for casing cover	1	2	3	100%
	412.3	O-ring set for rotor	1	2	3	100%

Kits	Part No.	Description	1	2	3	4 and more
Kit for coupling	-	Flexible gear wheel for coupling	1	1	1	30%
	-	Elastomer ring for coupling	1	1	1	30%
Kit of sealing elements for mechanical safety pressure relief valve	412.4	O-ring for piston of safety pressure relief valve	1	2	3	100%
	412.5	O-ring for piston of bush	1	2	3	100%
Kit of sealing elements for pneumatic safety pressure relief valve	412.14	O-ring for flange	1	2	3	100%
	412.15	O-ring for piston	1	2	3	100%
	412.16	O-ring for casing	1	2	3	100%
	412.17	O-ring for casing cover	1	2	3	100%
	412.18	O-ring for piston rod	1	2	3	100%
	412.19	O-ring for inner insert	1	2	3	100%
	412.20	O-ring for insert	1	2	3	100%
	412.21	O-ring for cover	1	2	3	100%
Kit for heating	412.9	O-ring for heating of casing	1	2	3	100%

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8 Trouble-shooting

⚠ WARNING

Improper work to remedy faults

Risk of injury!

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

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

A Excessive power input
B Pump does not withdraw any fluid (pump takes in air)
C Rotors worn
D Pump is running, but does not deliver
E Pump delivers insufficient flow rate
F Unusual vibrations and/or noises
G Pump overheated
H Motor overheated
I Rotor life too short
J Bearing life too short

Table 27: Trouble-shooting

A	B	C	D	E	F	G	H	I	J	Possible cause	Remedy[6)]
✗	✗	-	-	-	✗	✗	✗	-	-	Viscosity of fluid handled too low	Reduce speed. Increase fluid temperature.
✗	-	-	-	-	-	-	✗	-	-	Fluid temperature too low	Increase fluid temperature. Heat pump casing.
✗	-	✗	-	✗	-	✗	✗	✗	-	Excessive back pressure	Remove any resistances in discharge line. Increase pipe diameter. Decrease number of elbows in the discharge line.
✗	-	-	✗	✗	-	✗	✗	-	-	Gland packing packed incorrectly	Re-pack gland packing.
✗	-	-	-	-	✗	✗	✗	-	-	Speed too high	Reduce speed.
✗	-	-	✗	✗	✗	✗	✗	-	-	Faulty coupling	Check coupling. Replace it if required.
✗	-	✗	-	-	✗	✗	✗	✗	-	Rolling element bearings of pump and/ or motor worn	Replace bearings.
✗	-	✗	-	-	✗	✗	✗	✗	-	Gear wheels worn or synchronised incorrectly	Replace gear wheels and/or re-synchronise them.
✗	-	-	-	-	✗	-	✗	-	-	Insufficient oil quantity / incorrect oil in gear unit and bearing bracket	Replace/top up oil. (⇨ Section 6.1.2, Page 40)
✗	-	✗	-	-	✗	✗	✗	✗	-	Rotors rub against casing and/or casing cover.	Verify rated pressure against actual operating pressure.
✗	-	-	-	✗	✗	✗	✗	-	-	Rotors worn	Replace rotors.
-	✗	-	✗	✗	✗	-	-	-	-	NPSHavailable smaller than pump's NPSHrequired.	Improve suction conditions and flow conditions. Reduce speed. Reduce fluid temperature.
-	✗	-	-	✗	✗	-	-	-	-	Pump takes in air.	Check entire piping. Seal it if required. Check gland packing. Replace it if required.
-	✗	-	✗	✗	-	-	-	-	-	Pump and inlet line not primed sufficiently	Prime pump and inlet line. Check suction-side conditions. Repeat pump start-up.

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

A	B	C	D	E	F	G	H	I	J	Possible cause	Remedy[6)]
-	✗	-	✗	✗	✗	-	-	-	-	Clogged suction line, or valves in piping closed or not opened enough	Check suction line. Remove any foreign matter. Check all valves. Check filter. Clean or replace it as required.
-	-	✗	-	-	✗	✗	-	✗	-	Excessive temperature of the fluid handled	Reduce fluid temperature. Cool pump casing and casing cover.
-	-	✗	-	-	-	-	-	✗	✗	Solid particles in fluid handled	Clean piping and install filter.
-	-	✗	-	-	✗	-	-	-	-	Excessive forces at pump nozzles	Check pipeline connections. Fit expansion joints if required. Anchor and support piping upstream of pump.
-	-	-	✗	-	-	-	-	-	-	Wrong direction of rotation	Change the direction of rotation.
-	-	-	✗	✗	✗	-	-	-	-	Faulty safety pressure relief valve	Check safety pressure relief valve. Clean or replace it as required.
-	-	-	-	✗	-	-	-	-	-	Viscosity of fluid handled too low / excessive backflow of fluid handled	Increase speed. Reduce fluid temperature.
-	-	-	-	-	✗	-	-	-	-	Insufficiently secured pump and piping system	Check anchoring of pump or pump set. Support piping sufficiently. Use expansion joints if required.
-	-	-	-	-	-	-	✗	-	-	Motor cooled insufficiently.	Check motor cooling. Clean fan if required. Install external fan.
-	-	-	-	-	-	-	-	-	✗	Insufficient flushing	Check flushing unit. Increase flow rate and/or pressure of flushing liquid.
-	-	-	-	-	✗	-	-	-	-	Misalignment of coupling	▪ Take system out of service. ▪ Rectify causes of alignment change (e.g. tighten loose foundation bolts) ▪ Check coupling alignment. Correct it if required. ▪ Check coupling element for wear.
-	-	-	✗	✗	-	-	-	-	-	Flexible element of coupling worn	▪ Take system out of service. ▪ Replace flexible element.
-	-	-	✗	✗	-	-	-	-	-	Axial movement of a flange	▪ Take system out of service. ▪ Verify correct alignment of all components and tightening of adjusting screws.
-	-	-	✗	✗	-	-	-	-	-	Misalignment of flexible element of coupling	▪ Take system out of service. ▪ Eliminate cause of alignment changes or vibrations. ▪ Check coupling for wear.

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9 Related Documents

9.1 Exploded view and list of components

9.1.1 Vitalobe design standard BB

9.1.1.1 Vitalobe size 100

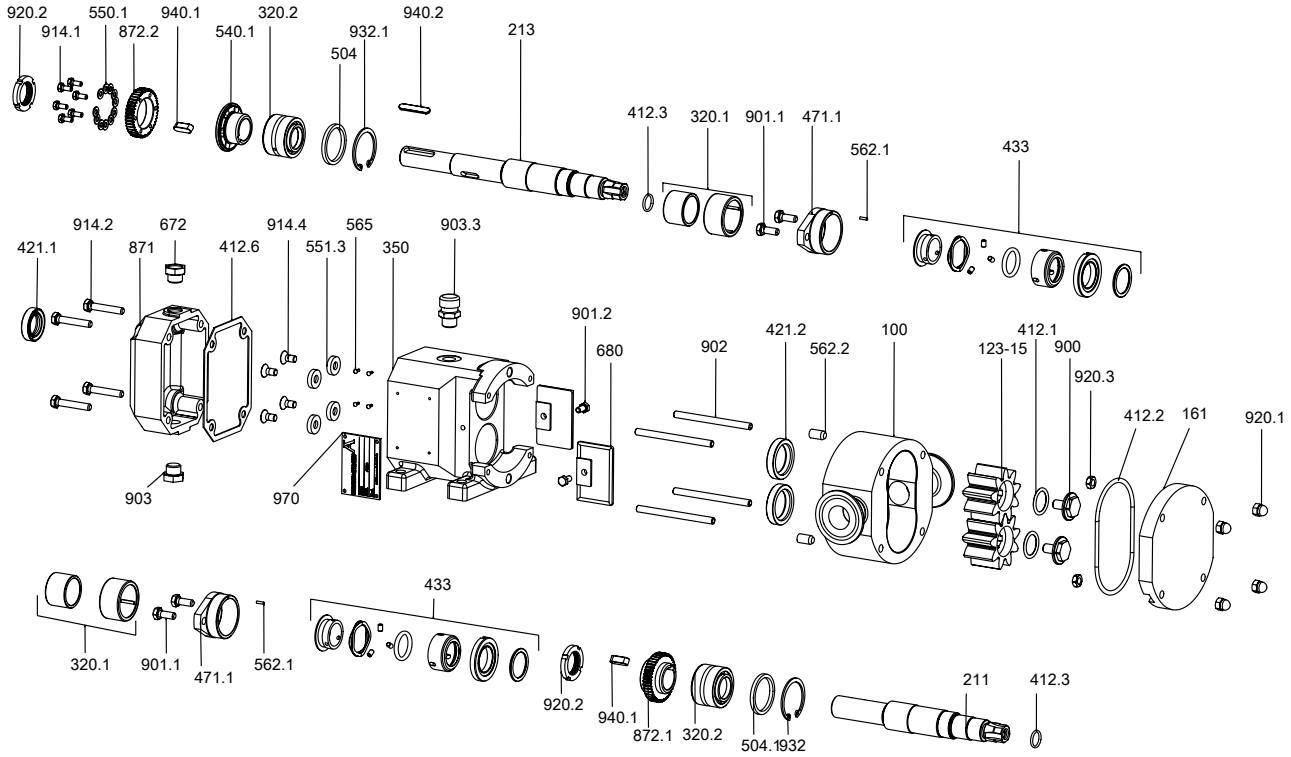

Fig. 31: Exploded view of Vitalobe size 100

Table 28: List of components

Part No.	Description	Part No.	Description
100	Casing	562.1/.2	Parallel pin
123-15	Rotor	565	Rivet
161	Casing cover	672	Vent plug
211	Pump shaft	680	Guard
213	Top shaft	871	Gear housing
320.1/.2	Rolling element bearing	872.1/.2	Gear wheel
350	Bearing housing	900	Screw
412.1/.2/.3/.6	O-ring	901.1/.2	Hexagon head bolt
421.1/.2	Lip seal	902	Stud
433	Mechanical seal	903	Screw plug
471.1	Seal cover	914.1/.2/.4	Hexagon socket head cap screw
504.1	Spacer ring	920.1/.2/.3	Nut
540.1	Bush	932.1	Circlip
550.1	Disc	940.1/.2	Key
551.3	Spacer disc	970	Label/plate

9.1.1.2 Vitalobe sizes 105, 110, 115

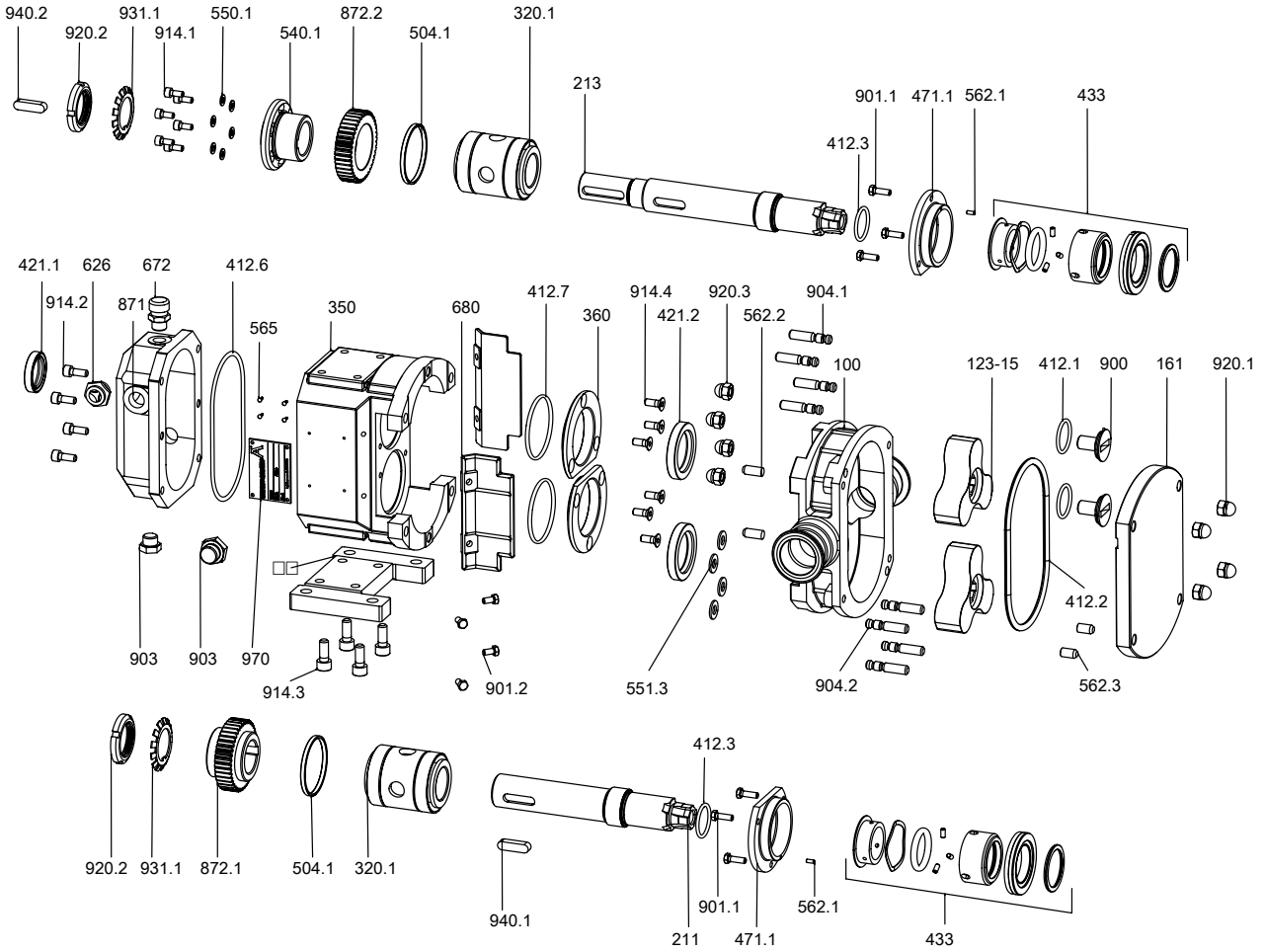

Fig. 32: Exploded view of Vitalobe sizes 105, 110, 115

Table 29: List of components

Part No.	Description	Part No.	Description
100	Casing	562.1/.2/.3	Parallel pin
123-15	Rotor	565	Rivet
161	Casing cover	626	Sight glass
211	Pump shaft	672	Vent plug
213	Top shaft	680	Guard
320.1	Rolling element bearing	871	Gear housing
350	Bearing housing	872.1/.2	Gear wheel
360	Bearing cover	900	Screw
412.1/.3/.6/.7	O-ring	901.1/.2	Hexagon head bolt
421.1/.2	Lip seal	903	Screw plug
433	Mechanical seal	904.1/.2	Grub screw
471.1	Seal cover	914.1/.2/.3/.4	Hexagon socket head cap screw
504.1	Spacer ring	920.1/.2/.3	Nut
540.1	Bush	931.1	Lock washer
550.1	Disc	940.1/.2	Key
551.3	Spacer disc	970	Label/plate

9.1.1.3 Vitalobe sizes 215 to 490

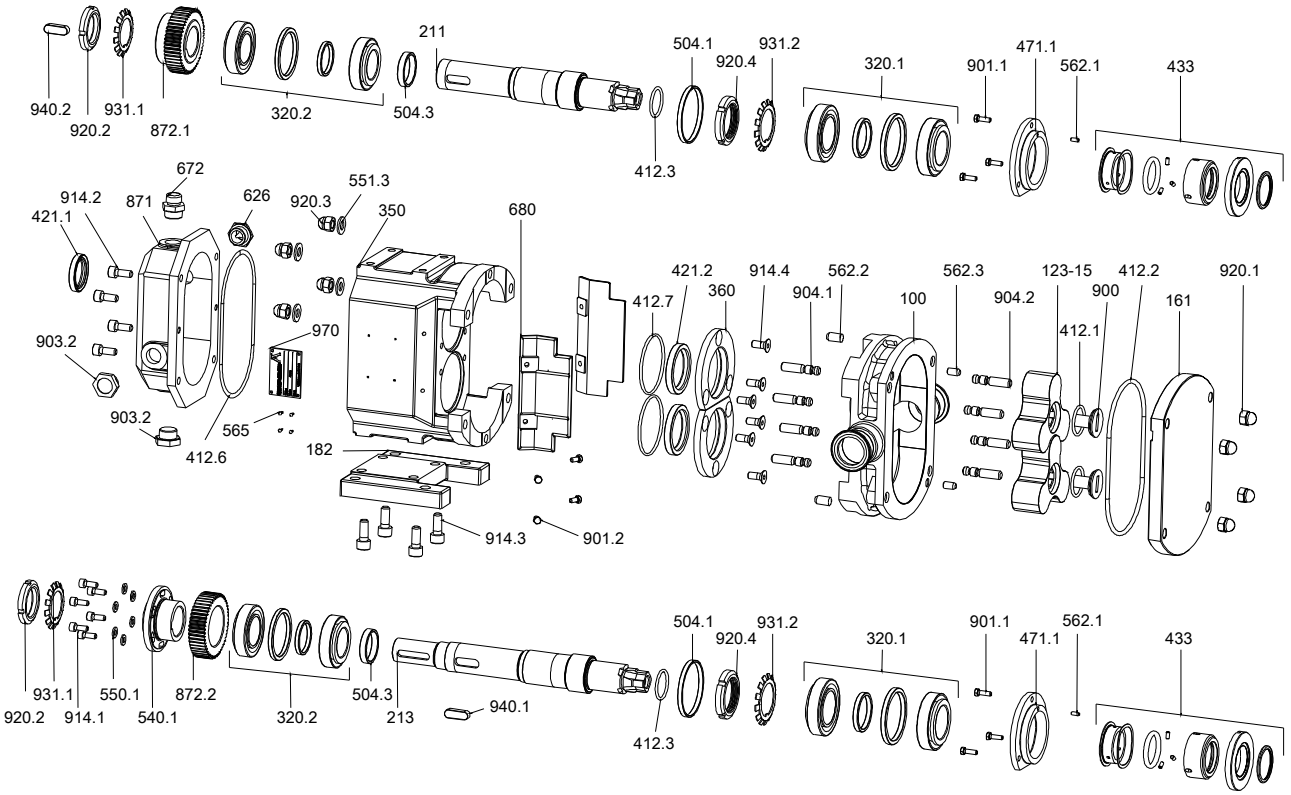

Fig. 33: Exploded view of Vitalobe sizes 215 to 490

Table 30: List of components

Part No.	Description	Part No.	Description
100	Casing	562.1/.2/.3	Parallel pin
123-15	Rotor	565	Rivet
161	Casing cover	626	Sight glass
182	Foot	672	Vent plug
211	Pump shaft	680	Guard
213	Top shaft	871	Gear housing
320.1/.2	Rolling element bearing	872.1/.2	Gear wheel
350	Bearing housing	900	Screw
360	Bearing cover	901.1/.2	Hexagon head bolt
412.1/.2/.3/.6/.7	O-ring	903.2	Screw plug
421.1/.2	Lip seal	904.1/.2	Grub screw
433	Mechanical seal	914.1/.2/.3/.4	Hexagon socket head cap screw
471.1	Seal cover	920.1/.2/.3/.4	Nut
504.1/.3	Spacer ring	931.1/.2	Lock washer
540.1	Bush	940.1/.2	Key
550.1	Disc	970	Label/plate
551.3	Spacer disc		

9.1.1.4 Single mechanical seal and single mechanical seal with flushing system

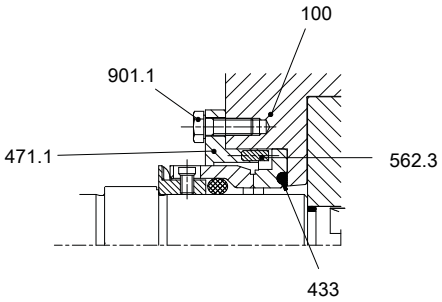

Fig. 34: Single mechanical seal

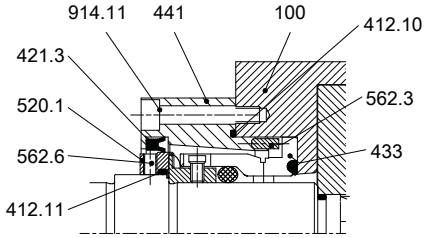

Fig. 35: Single mechanical seal with flushing system

Table 31: List of components

Part No.	Description	Part No.	Description
100	Casing	471.1	Seal cover
412.10/.11	O-ring	520.1	Sleeve
421.3	Lip seal	562.3/.6	Parallel pin
433	Mechanical seal	901.1	Hexagon head bolt
441	Shaft seal housing	914.11	Hexagon socket head cap screw

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9.1.2 Vitalobe design standard B

9.1.2.1 Vitalobe size 100

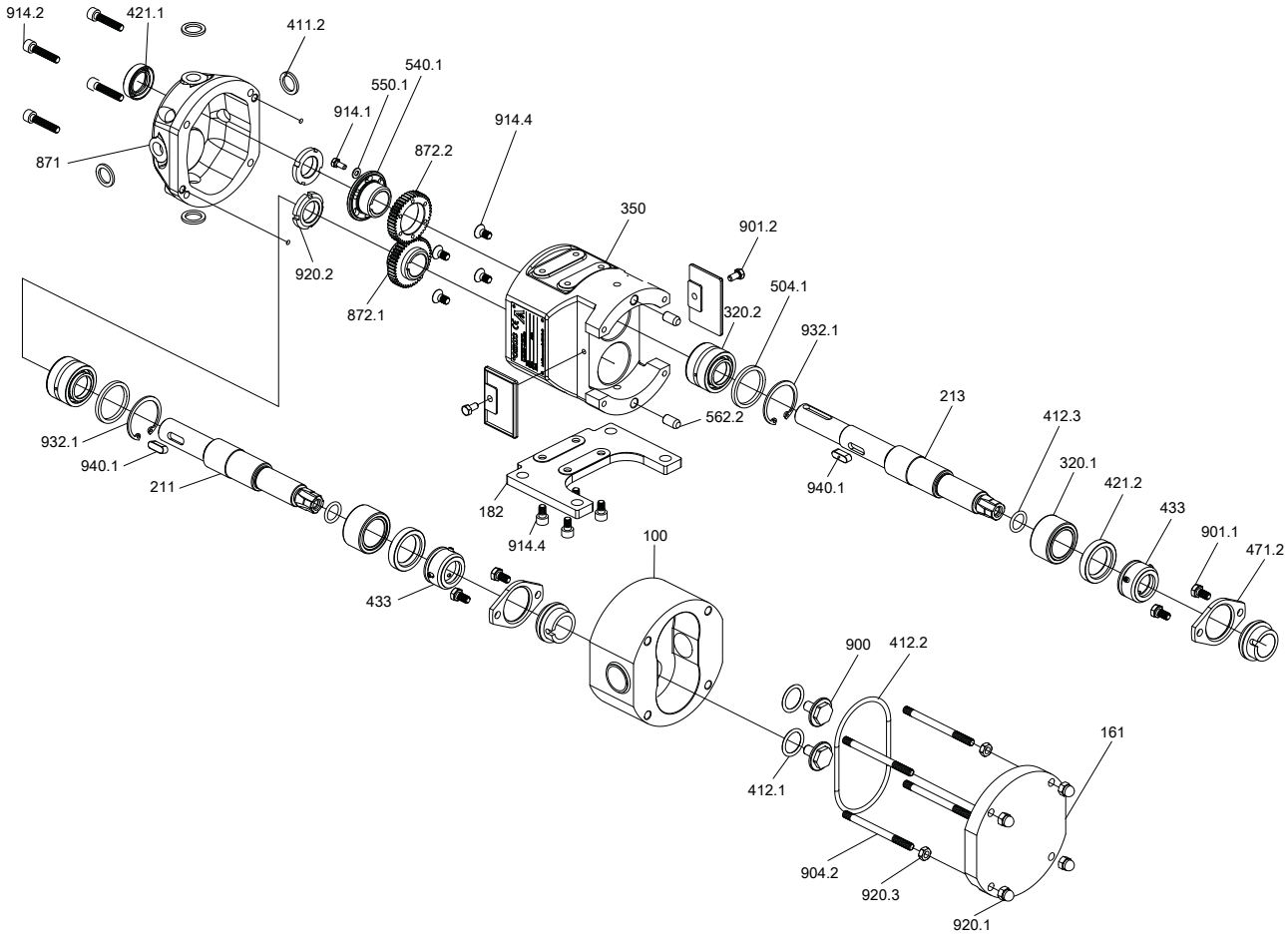
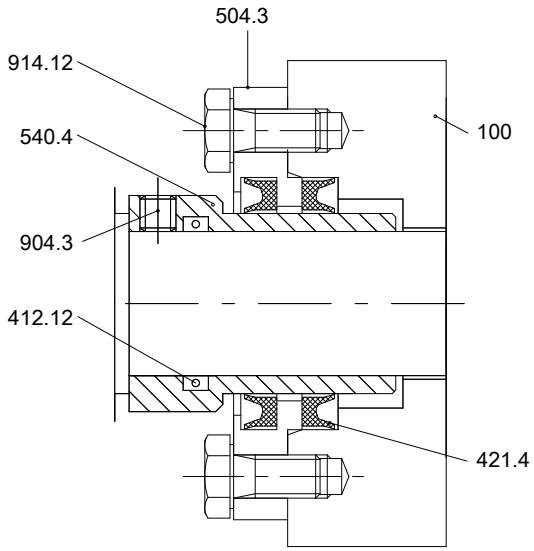


Fig. 36: Exploded view of Vitalobe size 100

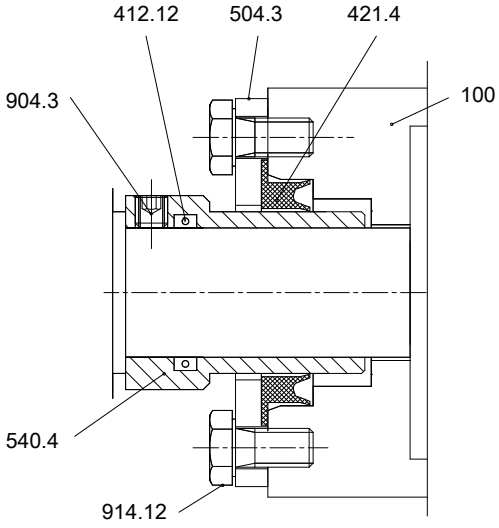
Table 32: List of components

Part No.	Description	Part No.	Description
100	Casing	540.1	Bush
161	Casing cover	550.1	Disc
182	Foot	562.2	Parallel pin
211	Pump shaft	871	Gear housing
213	Top shaft	872.1/.2	Gear wheel
320.1/.2	Rolling element bearing	900	Screw
350	Bearing housing	901.1/.2	Hexagon head bolt
411.2	Joint ring	904.2	Grub screw
412.1/.2/.3	O-ring	914.1/.2/.4	Hexagon socket head cap screw
421.1/.2	Lip seal	920.1/.2/.3	Nut
433	Mechanical seal	932.1	Circlip
471.2	Seal cover	940.1/.2	Key
504.1	Spacer ring		

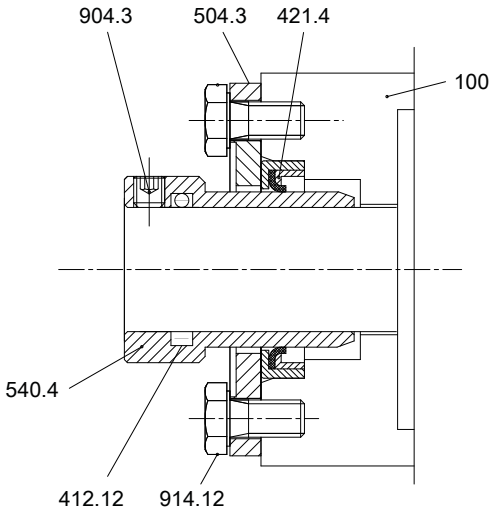
9.1.2.2 Shaft seal size 100



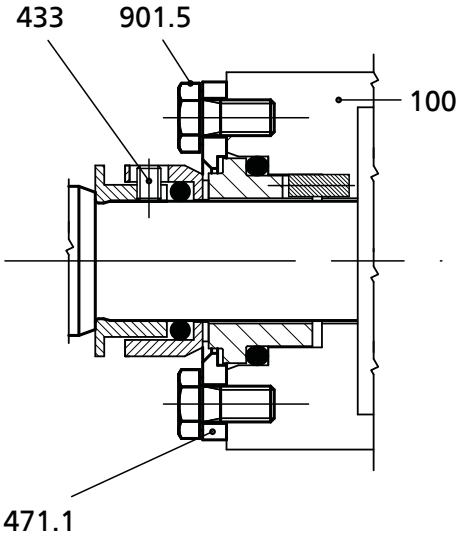
Shaft seal ring, type UM



Shaft seal ring, type S1



Shaft seal ring, type HN



Single mechanical seal

Table 33: List of components

Part No.	Description	Part No.	Description
100	Casing	504.3	Spacer ring
412.12	O-ring	540.4	Bush
421.4	Lip seal	904.3	Grub screw
433	Mechanical seal	914.12	Hexagon socket head cap screw

9.1.2.3 Vitalobe sizes 105, 110, 115

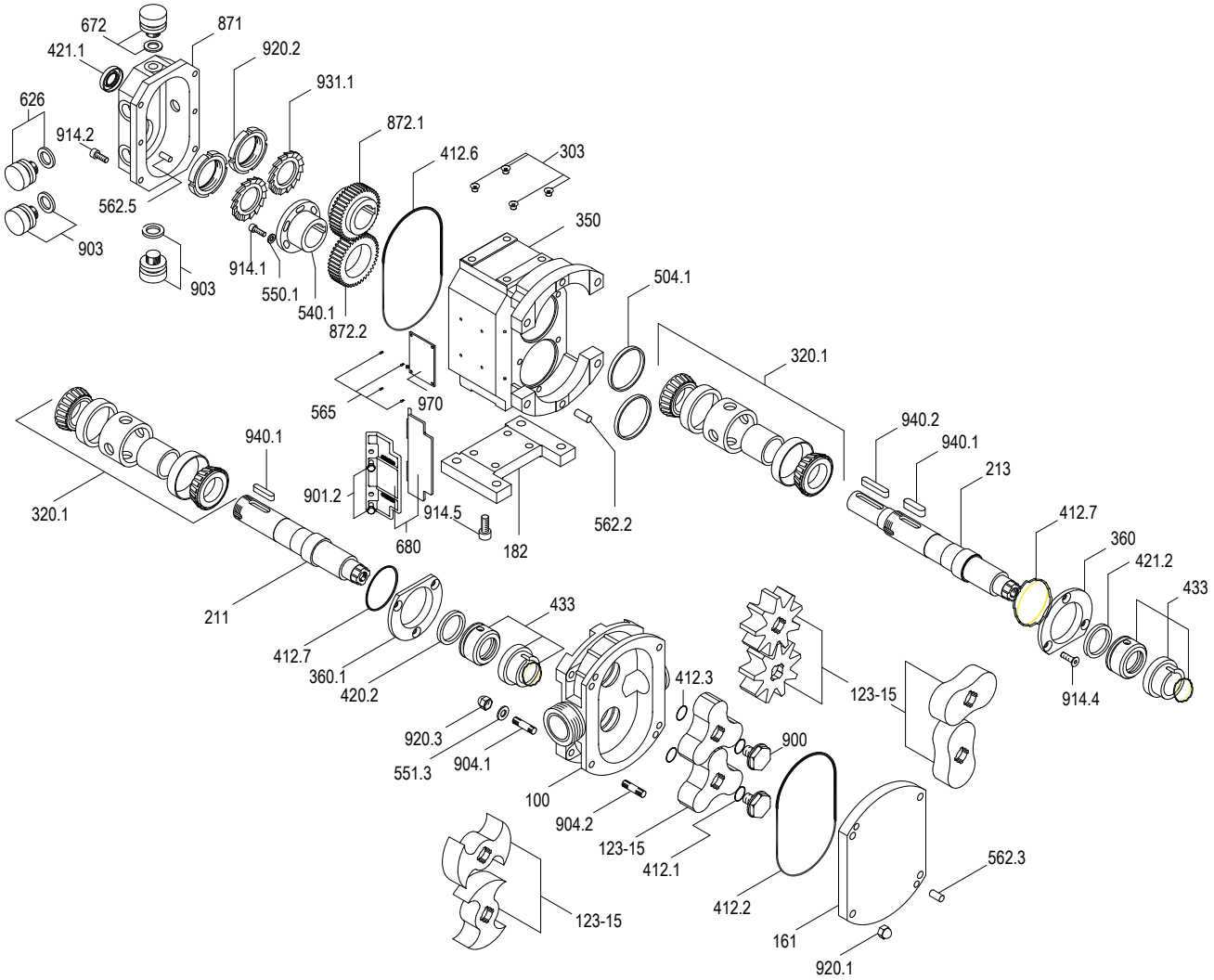
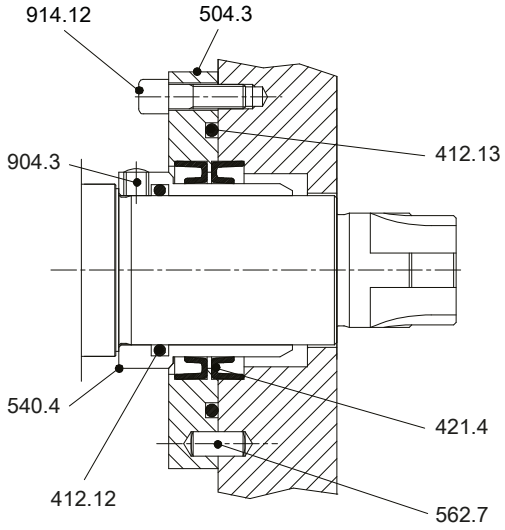


Fig. 37: Exploded view of Vitalobe sizes 150, 110, 115

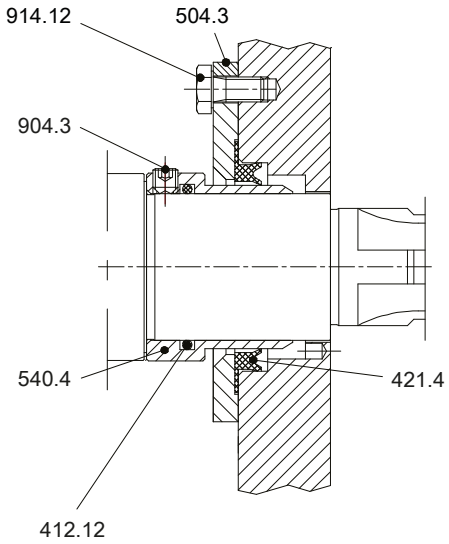
Table 34: List of components

Part No.	Description	Part No.	Description
100	Casing	551.3	Spacer disc
123-15	Rotor	562.2/.3/.5	Parallel pin
161	Casing cover	565	Rivet
182	Foot	626	Sight glass
211	Pump shaft	672	Vent plug
213	Top shaft	680	Guard
303	Thrust and radial bearing	871	Gear housing
320.1	Rolling element bearing	872.1/.2	Gear wheel
350	Bearing housing	900	Screw
360.1	Bearing cover	901.2	Hexagon head bolt
412.1/.2/.3/.6/.7	O-ring	903	Screw plug
420.2	Shaft seal ring	904.1/.2	Grub screw
421.1/.2	Lip seal	914.1/.2/.4/.5	Hexagon socket head cap screw
433	Mechanical seal	920.1/.2/.3	Nut
504.1	Spacer ring	931.1	Lock washer
540.1	Bush	940.1/.2	Key
550.1	Disc	970	Label/plate

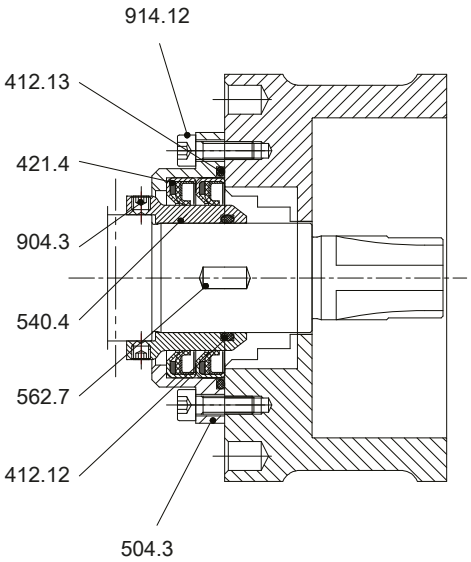
9.1.2.4 Shaft seal for sizes 105, 110, 115



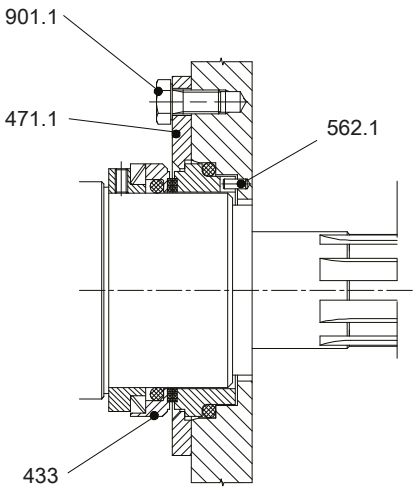
Shaft seal ring, type UM



Shaft seal ring, type S1



Double shaft seal ring, type HN



Single mechanical seal, type U7K

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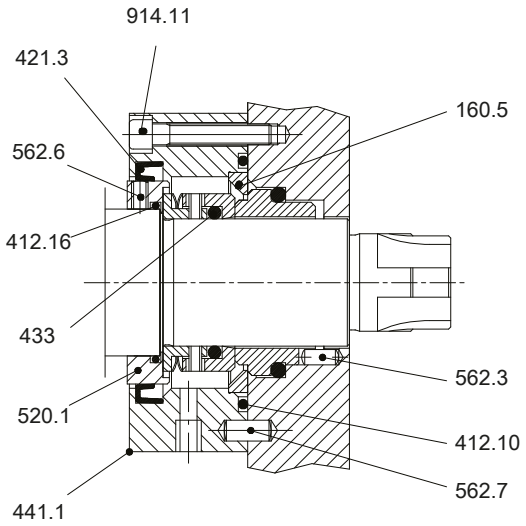
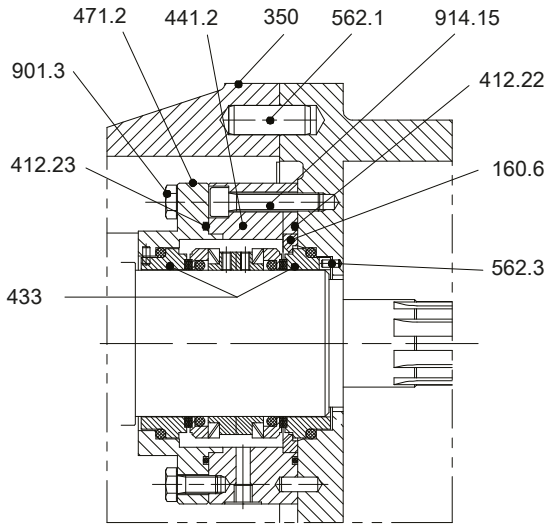


Single mechanical seal with flushing system, type KL2A, U7K, C5E



Double mechanical seal in back-to-back arrangement

Table 35: List of components

Part No.	Description	Part No.	Description
160.5/.6	Cover	504.3	Spacer ring
350	Bearing housing	520.1	Sleeve
412.10/.12/.13/.16/.22/.23	O-ring	540.4	Bush
421.3/.4	Lip seal	562.1/.3/.6/.7	Parallel pin
433	Mechanical seal	901.1/.3	Hexagon head bolt
441.1/.2	Shaft seal housing	904.3	Grub screw
471.1/.2	Seal cover	914.11/.12/.15	Hexagon socket head cap screw

9.1.2.5 Vitalobe sizes 215 to 490

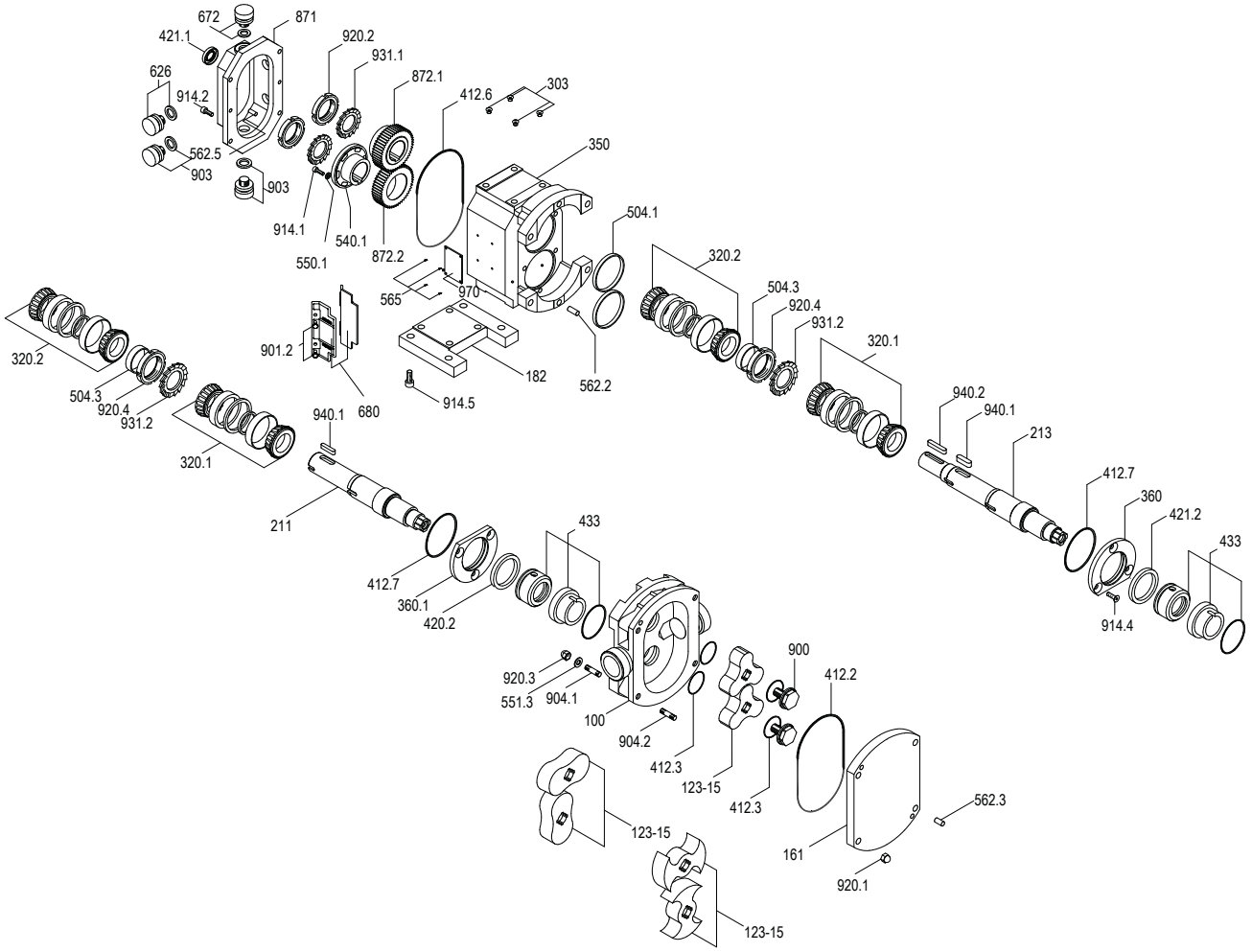


Fig. 38: Exploded view of Vitalobe sizes 215 to 490

Table 36: List of components

Part No.	Description	Part No.	Description
100	Casing	551.3	Spacer disc
123-15	Rotor	562.2/.3/.5	Parallel pin
161	Casing cover	565	Rivet
182	Foot	626	Sight glass
211	Pump shaft	672	Vent plug
213	Top shaft	680	Guard
303	Thrust and radial bearing	871	Gear housing
320.1/.2	Rolling element bearing	872.1/.2	Gear wheel
350	Bearing housing	900	Screw
360.1	Bearing cover	901.2	Hexagon head bolt
412.2/.3/.6/.7	O-ring	903	Screw plug
420.2	Shaft seal ring	904.1/.2	Grub screw
421.1/.2	Lip seal	914.1/.2/.4/.5	Hexagon socket head cap screw
433	Mechanical seal	920.1/.2/.3/.4	Nut
504.1/.3	Spacer ring	931.1/.2	Lock washer
540.1	Bush	940.1/.2	Key
550.1	Disc	970	Label/plate

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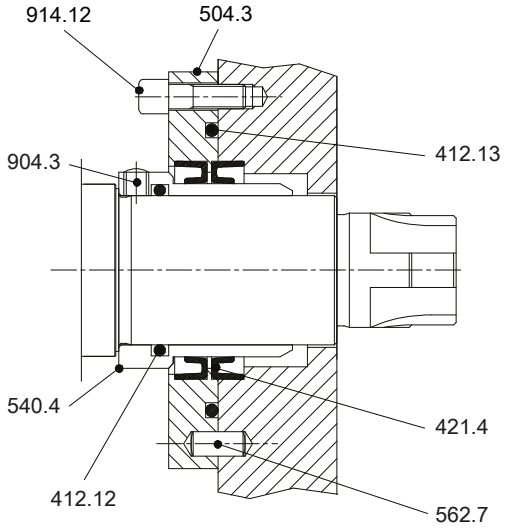
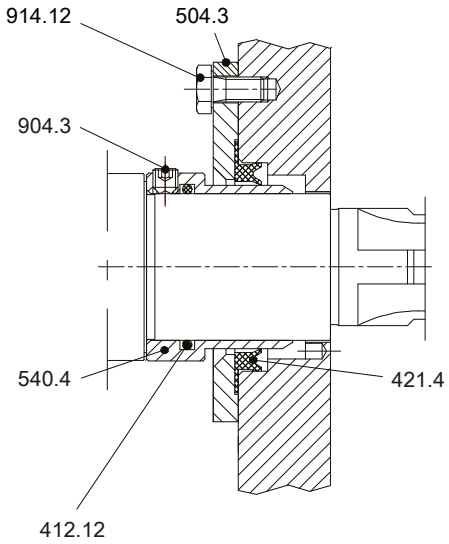
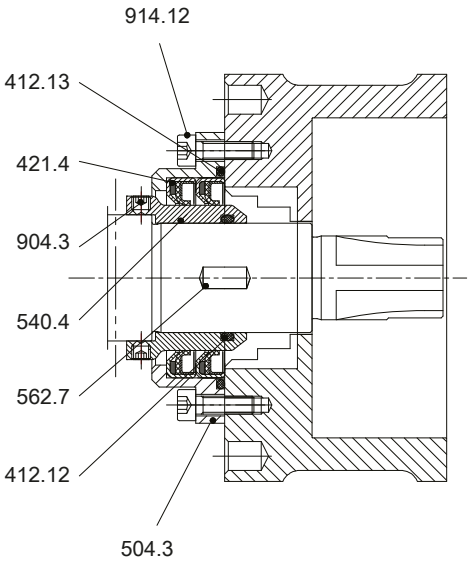
9.1.2.6 Shaft seal for sizes 215 to 490



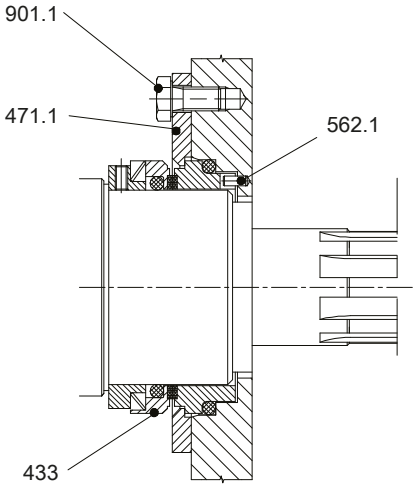
Shaft seal ring, type UM



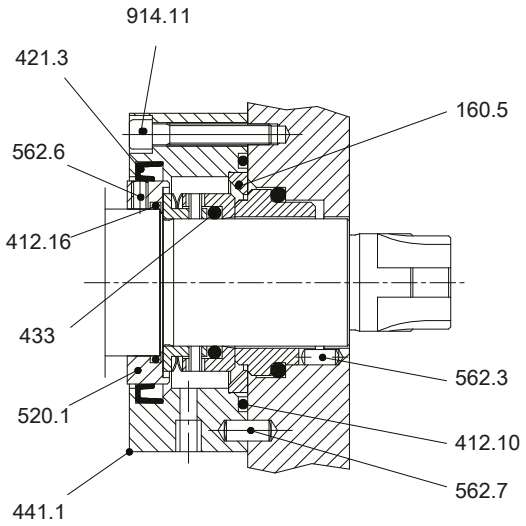
Shaft seal ring, type S1



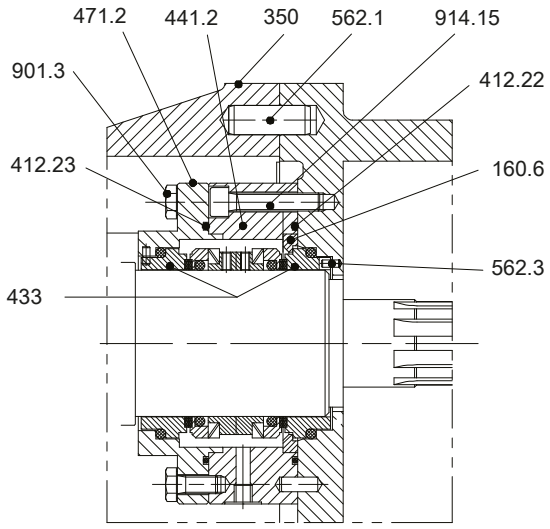
Double shaft seal ring, type HN



Single mechanical seal, type U7K



Single mechanical seal with flushing system, type KL2A, U7K, C5E



Double mechanical seal in back-to-back arrangement

Table 37: List of components

Part No.	Description	Part No.	Description
160.5/.6	Cover	504.3	Spacer ring
350	Bearing housing	520.1	Sleeve
412.10/.12/.13/.16/.22/.23	O-ring	540.4	Bush
421.3/.4	Lip seal	562.1/.3/.6/.7	Parallel pin
433	Mechanical seal	901.1/.3	Hexagon head bolt
441.1/.2	Shaft seal housing	904.3	Grub screw
471.1/.2	Seal cover	914.11/.12/.15	Hexagon socket head cap screw

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9.1.2.7 Vitalobe sizes 550, 660, 680

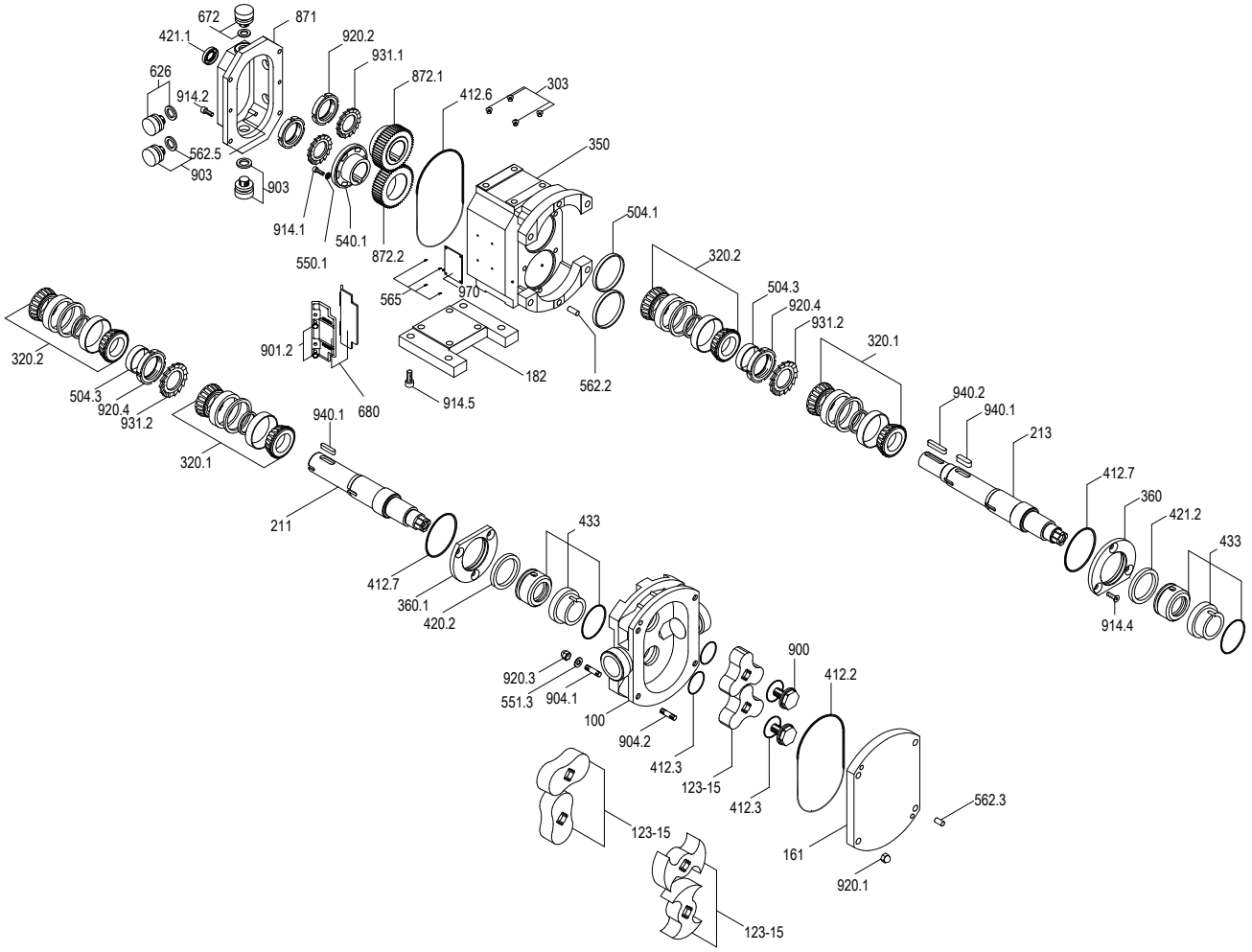

Fig. 39: Exploded view of Vitalobe size 550

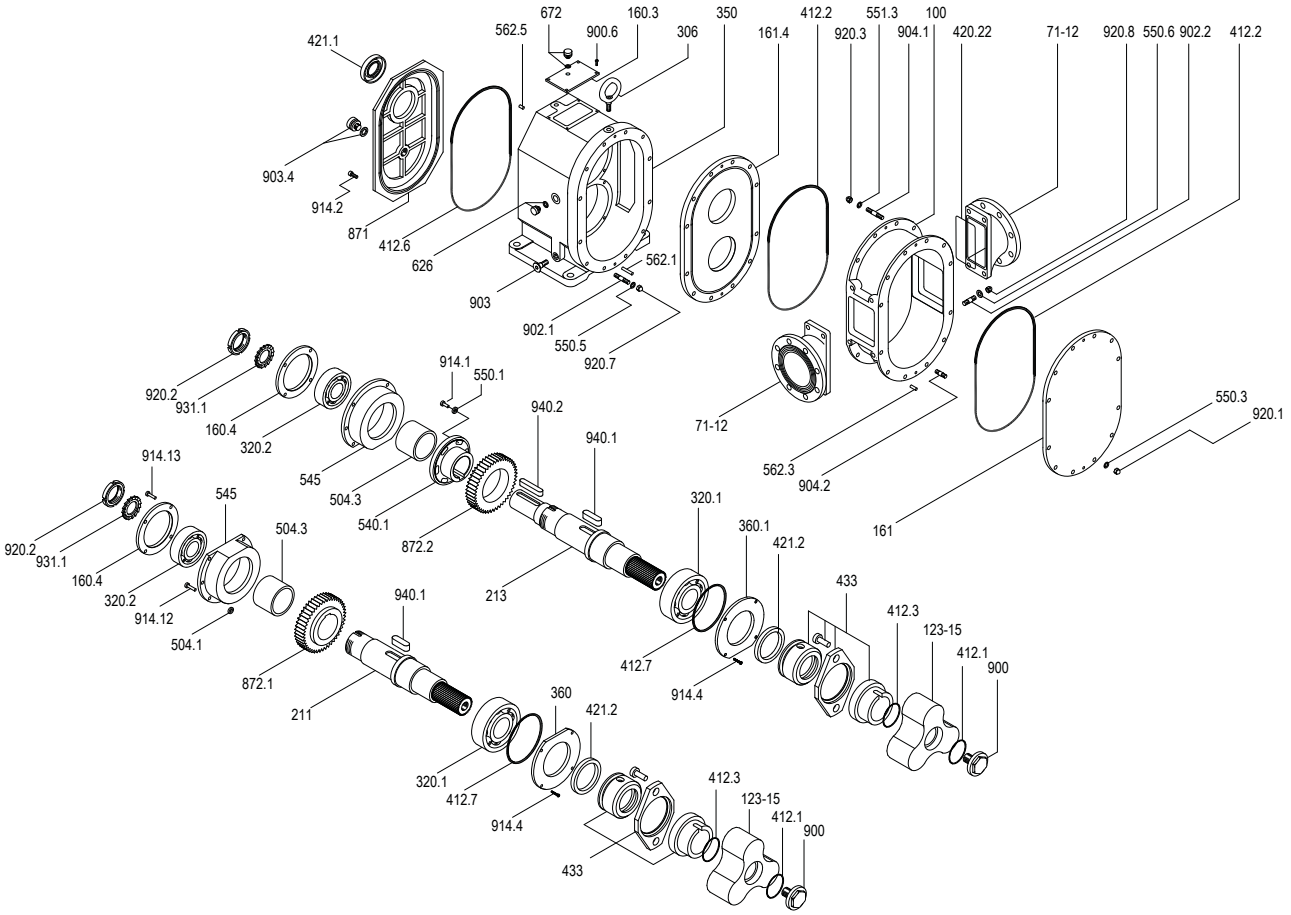

Fig. 40: Exploded view of Vitalobe sizes 660, 680

Table 38: List of components

Part No.	Description	Part No.	Description
100	Casing	551.3	Spacer disc
123-15	Rotor	562.1/.2/.3/.5	Parallel pin
160.3/.4	Cover	565	Rivet
161.4	Casing cover	626	Sight glass
182	Foot	672	Vent plug
211	Pump shaft	680	Guard
213	Top shaft	71-12	Connection nozzle
303	Thrust and radial bearing	871	Gear housing
306	Eyebolt	872.1/.2	Gear wheel
320.1/.2	Rolling element bearing	900.6	Screw
350	Bearing housing	901.2	Hexagon head bolt
360.1	Bearing cover	902.1/.2	Stud
412.1/.2/.3/.6/.7	O-ring	903.1/.2/.4	Screw plug
420.2/.22	Shaft seal ring	904.1/.2	Grub screw
421.1/.2	Lip seal	914.1/.2/.4/.5/.12/.13	Hexagon socket head cap screw
433	Mechanical seal	920.1/.2/.3/.4/.7/.8	Nut
504.1/.3	Spacer ring	931.1/.2	Lock washer
540.1	Bush	940.1/.2	Key
545	Bearing bush	970	Label/plate
550.1/.3/.5/.6	Disc		

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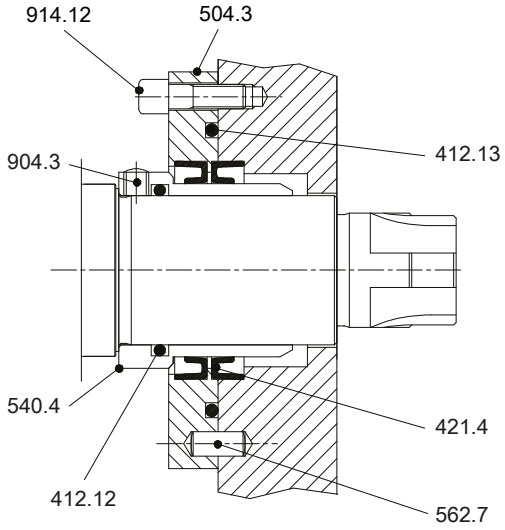
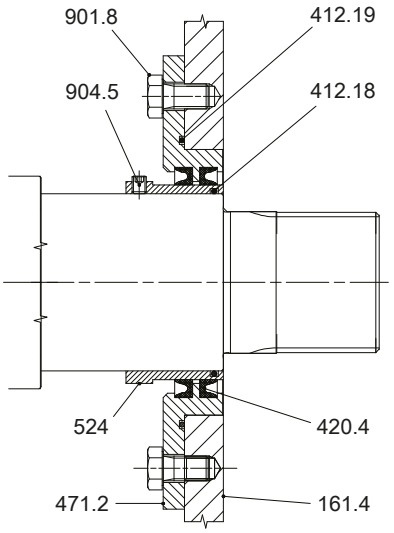
9.1.2.8 Shaft seal for sizes 550, 660, 680

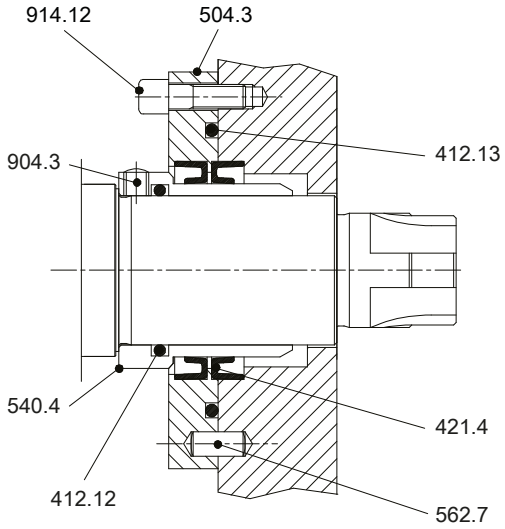


Size 550

Shaft seal ring, type UM

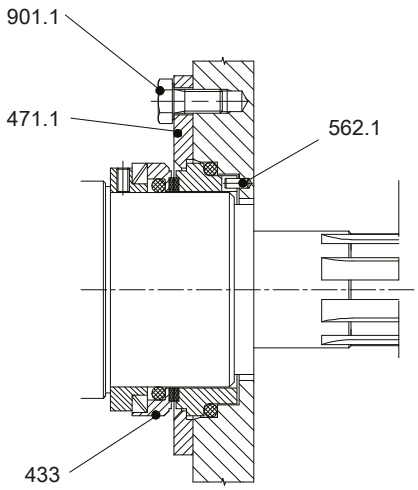


Sizes 660, 680

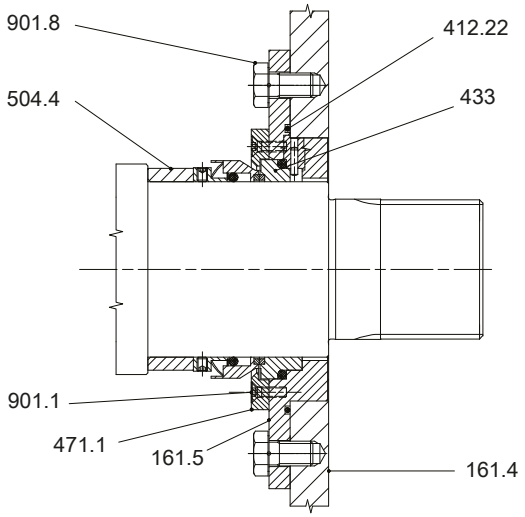


Size 550

Shaft seal ring, type S1

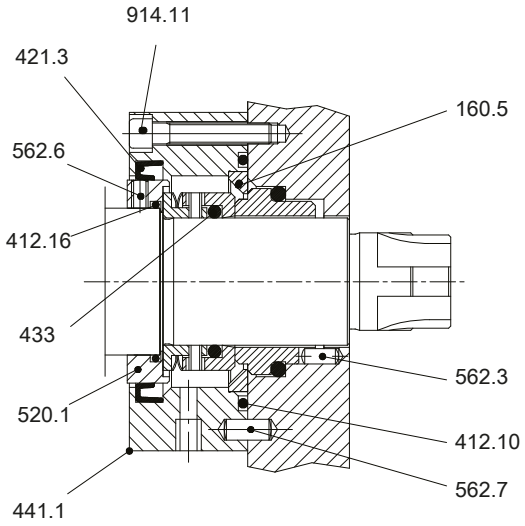


Size 550

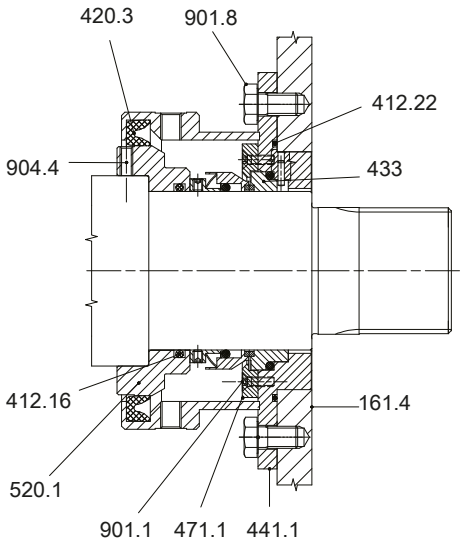


Sizes 660, 680

Single mechanical seal, type U7K



Size 550



Sizes 660, 680

Single mechanical seal with flushing system, type KL2A, U7K, C5E

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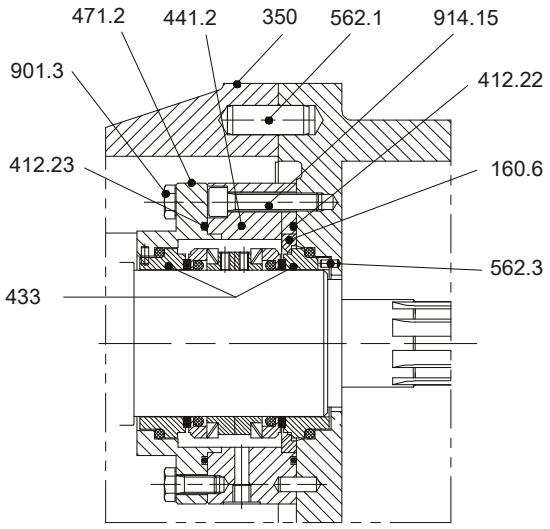
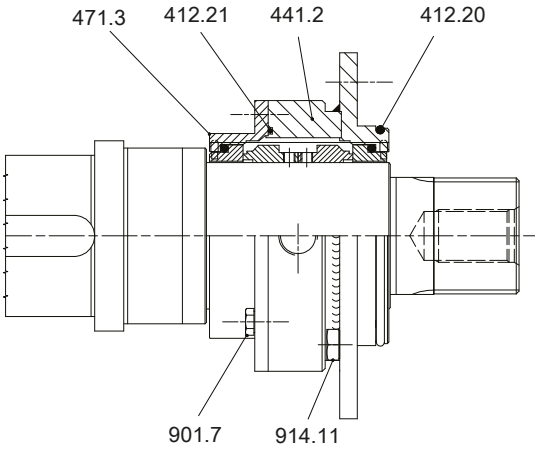


Size 550



Sizes 660, 680

Double mechanical seal in back-to-back arrangement

Table 39: List of components

Part No.	Description	Part No.	Description
160.4/.5/.6	Cover	504.3/.4	Spacer ring
161.4/.5	Casing cover	520.1	Sleeve
350	Bearing housing	524	Shaft protecting sleeve
412.10/.12/.13/.16/.18/.19/.20/.21/.22/.23	O-ring	540.4	Bush
420.3/.4	Shaft seal ring	562.1/.3/.6/.7	Parallel pin
421.3/.4	Lip seal	901.1/.3/.7/.8	Hexagon head bolt
433	Mechanical seal	904.3/.4/.5	Grub screw
441.1/.2	Shaft seal housing	914.11/.12/.15	Hexagon socket head cap screw
471.1/.2/.3	Seal cover		

10 EU Declaration of Conformity

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

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

Vitalobe

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 standards have been applied:
  - ISO 12100,
  - EN 809/A1,
  - EN 12162+A1
  - EN 349+A1
  - EN 953+A1
  - ISO 13857+A1
  - EN 13951+A1
    - Level 2+3: Vitalobe BB
    - Level 1: Vitalobe B
- Applied national technical standards and specifications, in particular:
  - EN 14847

Person authorised to compile the technical file:

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

The EU Declaration of Conformity was issued in/on:

Place, date

.....[7)].....

Name

Function

Company
Address

1969.83/06-EN

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

11 Certificate of Decontamination

Type: .....

Order number/

Order item number[8]: .....

Delivery date: .....

Field of application: .....

Fluid handled[8]: .....

Please tick where applicable[8]:

☐ Radioactive

☐ Explosive

☐ Corrosive

☐ Toxic

☐ Harmful

☐ Bio-hazardous

☐ Highly flammable

☐ Safe

Reason for return[8]: .....

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 adapter have also been cleaned.

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

☐ No special safety precautions are required for further handling.

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

.....

.....

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

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

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8 Required fields

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