RPK Process Pump

acc. to API 610 and VDMA 24 297, requirement class A (ISO 9905)
Reinforced Bearing Assemblies P 02as to P 08s; P 03as to P 06as
Up to nominal impeller diameter 501
Mechanical Seal

Works No.: _____

Type Series: _____

These operating instructions contain fundamental information and precautionary notes. Please read the manual thoroughly prior to installation of unit, electrical connection and commissioning.
It is imperative to comply with all other operating instructions referring to components of individual units.

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1 General

Caution This KSB pump has been developed in accordance with state-of-the-art technology; it is manufactured with utmost care and subject to continuous quality control.

These operating instructions are intended to facilitate familiarisation with the pump and its designated use.

The manual contains important information for reliable, proper and efficient operation. Compliance with the operating instructions is of vital importance to ensure reliability and a long service life of the pump and to avoid any risks.

These operating instructions do not take into account local regulations; the operator must ensure that such regulations are strictly observed by all, including the personnel called in for installation.

This pump / unit must not be operated beyond the limit values specified in the technical documentation for the medium handled, capacity, speed, density, pressure, temperature and motor rating. Make sure that operation is in accordance with the instructions laid down in this manual or in the contract documentation. (Contact the manufacturer, if required.)

The name plate indicates the type series / size, main operating data and works number; please quote this information in all queries, repeat orders and particularly when ordering spare parts.

If you need any additional information or instructions exceeding the scope of this manual or in case of damage please contact KSB's nearest customer service centre.

For noise characteristics please refer to section 4.3.6.

2 Safety

These operating instructions contain fundamental information which must be complied with during installation, operation and maintenance. Therefore this operating manual must be read and understood both by the installing personnel and the responsible trained personnel / operators prior to installation and commissioning, and it must always be kept close to the location of operation of the machine / unit for easy access.

Not only must the general safety instructions laid down in this chapter on "Safety" be complied with, but also the safety instructions outlined under specific headings.

2.1 Marking of Instructions in the Manual

The safety instructions contained in this manual whose non-observance might cause hazards to persons are specially marked with the general hazard sign, namely

safety sign in accordance with DIN 4844 - W9.

The electrical danger warning sign is

safety sign in accordance with DIN 4844 - W8.

The word

Caution

is used to introduce safety instructions whose non-observance may lead to damage to the machine and its functions.

Instructions attached directly to the machine, e.g.

- arrow indicating the direction of rotation
- markings for fluid connections

must always be complied with and be kept in perfectly legible condition at all times.

2.2 Personnel Qualification and Training

All personnel involved in the operation, maintenance, inspection and installation of the machine must be fully qualified to carry out the work involved.

Personnel responsibilities, competence and supervision must be clearly defined by the operator. If the personnel in question is not already in possession of the requisite know-how, appropriate training and instruction must be provided. If required, the operator may commission the manufacturer / supplier to take care of such training. In addition, the operator is responsible for ensuring that the contents of the operating instructions are fully understood by the responsible personnel.

2.3 Non-compliance with Safety Instructions

Non-compliance with safety instructions can jeopardise the safety of personnel, the environment and the machine itself. Non-compliance with these safety instructions will also lead to forfeiture of any and all rights to claims for damages.

In particular, non-compliance can, for example, result in:

- failure of important machine / plant functions
- failure of prescribed maintenance and servicing practices
- hazard to persons by electrical, mechanical and chemical effects
- hazard to the environment due to leakage of hazardous substances.

2.4 Safety Awareness

It is imperative to comply with the safety instructions contained in this manual, the relevant national health and safety regulations and the operator's own internal work, operation and safety regulations.

2.5 Safety Instructions for the Operator / User

- Any hot or cold components that could pose a hazard must be equipped with a guard by the operator.
- Guards which are fitted to prevent accidental contact with moving parts (e.g. coupling) must not be removed whilst the machine is operating.
- Leakages (e.g. at the shaft seal) of hazardous media handled (e.g. explosive, toxic, hot) must be contained so as to avoid any danger to persons and the environment. Pertinent legal provisions must be adhered to.
- Electrical hazards must be eliminated. (In this respect refer to the relevant safety regulations applicable to different countries and / or the local energy supply companies.)

2.6 Safety Instructions for Maintenance, Inspection and Installation Work

The operator is responsible for ensuring that all maintenance, inspection and installation work be performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.

The pump must have cooled down to ambient temperature, it must be drained and its pressure must be released.

Work on the machine must be carried out only during standstill. The shutdown procedure described in the manual for taking the machine out of service must be adhered to without fail.

Pumps or pump units handling media injurious to health must be decontaminated.

Immediately following completion of the work, all safety-relevant and protective devices must be re-installed and / or re-activated.

Please observe all instructions set out in the chapter on "Commissioning" before returning the machine to service.

2.7 Unauthorised Modification and Manufacture of Spare Parts

Modifications or alterations of the machine are only permitted after consultation with the manufacturer. Original spare parts and accessories authorised by the manufacturer ensure safety. The use of other parts can invalidate any liability of the manufacturer for consequential damage.

2.8 Unauthorised Modes of Operation

To ensure operational reliability and safety of the pump / unit supplied, the machine shall be used exclusively in accordance with its designated use as described in the following sections. The limits stated in the data sheet must not be exceeded under any circumstances.

3 Transport and Interim Storage

3.1 Transport

Transport of the unit requires proper preparation and handling. Always make sure that the pump or the unit remains in horizontal position during transport and cannot slip out of the transport suspension arrangement. Do not use lifting sling on the free shaft end of the pump or on the motor eyebolt.

⚠ If the pump / unit slips out of the suspension arrangement, it may cause personal injury and damage to property.

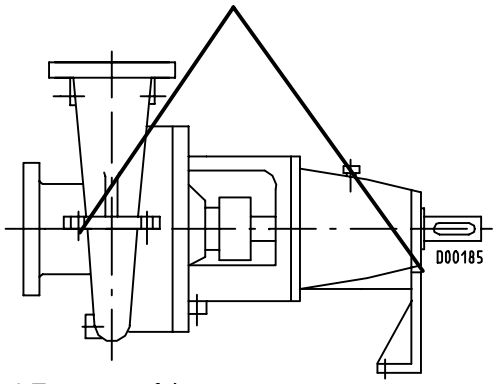


Fig. 3.1-1 Transport of the pump

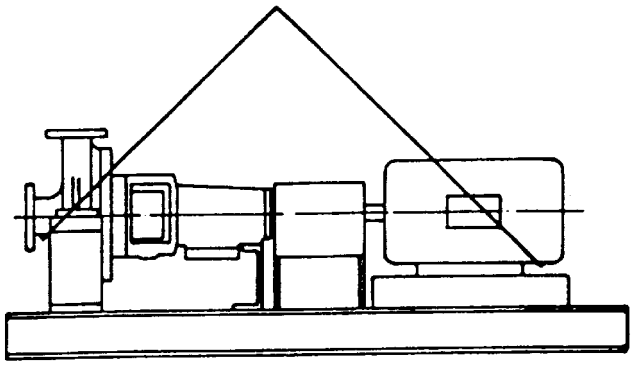


Fig. 3.1-2 Transport of the complete unit

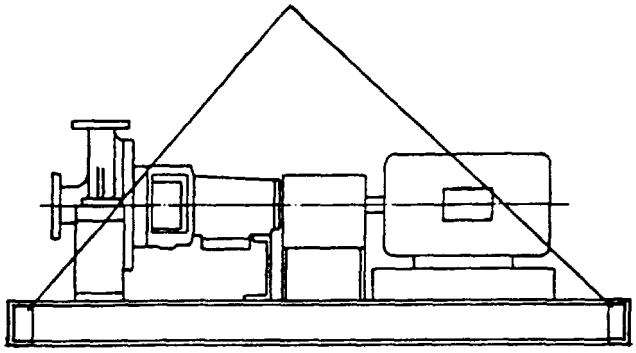


Fig. 3.1-3 Transport of the complete unit

3.2 Interim Storage (Indoors) / Preservation

When the unit is temporarily put into storage, only the wetted low alloy components (e.g. GG-25, GGG-40.3, GS-C25 etc.) must be preserved. Commercially available preservatives can be used for this purpose. Please observe the manufacturer's instructions for application / removal.

The relevant procedure is described in section 6.3.

The unit / pump should be stored in a dry room where the atmospheric humidity is as constant as possible.

If stored outdoors, the unit and crates must be covered by waterproof material to avoid any contact with humidity.

Caution Protect all stored goods against humidity, dirt, vermin and unauthorised access!

All openings of the assembled unit components are closed and must only be opened when required during installation.

All blank parts and surfaces of the pump are oiled or greased (silicone-free oil and grease) to protect them against corrosion.

4 Description of the Product and Accessories

4.1 Technical Specification

RPK pumps are used for handling products in refineries, chemical and petrochemical plants, coal conversion plants, in environmental engineering applications and other branches of industry.

4.2 Designation

RPK I 100 - 280

Type Series
Additional code
Discharge nozzle DN in mm
Nominal impeller dia. in mm

Additional codes:
I = inducer
X = special version
(detailed in our order confirmation)

4.3 Design Details

Horizontal radially split volute casing pump in back pull-out design in accordance with API 610, heavy duty, and VDMA 24 297, requirement class A (ISO 9905), with radial impeller, single stage, single entry, centreline feet.

4.3.1 Pump Casing

Radially split, consisting of volute casing with casing wear ring and casing cover. Volute casing and casing cover form the internal pump chamber. The wall thickness of the casing includes a corrosion allowance of 1/8" (approx. 3 mm).

On some pump sizes, pump casings have a double volute, in order to compensate radial forces.

RPK size 50-400 is fitted with an inducer.

The casing cover holds the discharge-side casing wear ring and the neck bush (for exceptions refer to 4.3.2)

The neck bush can be used as throttling bush for the circulation flow.

Together with the bearing bracket lantern, the casing cover forms the heating or cooling chamber for the shaft seal.

4.3.1.1 Pump feet

Generally centreline pump feet.

Centreline pump feet are specified by API 610 for product temperatures higher than 177 °C and by VDMA 24 297-A for product temperatures higher than 200 °C.

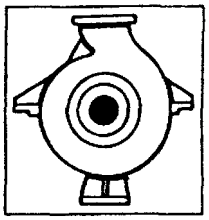


Fig. 4.3.1.1-1 Casing with centreline pump feet

4.3.1.2 Nozzle positions

Axial inlet nozzle, radial discharge nozzle pointing vertically upwards.

4.3.2 Impeller

Closed radial impeller. Impellers are fitted with wear rings on the suction and the discharge side or only on the suction side.

Wear rings are locked with grub screws.

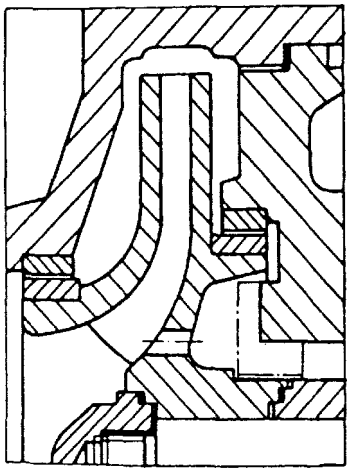
(Can also be locked with three weld points)

Balancing

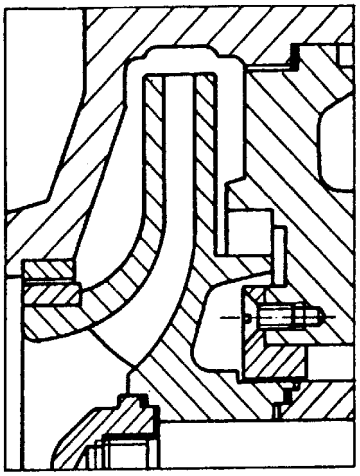
Version A: balancing of axial thrust by means of sealing clearance on both sides and balancing holes.

Version B/C: without hydraulic balancing.

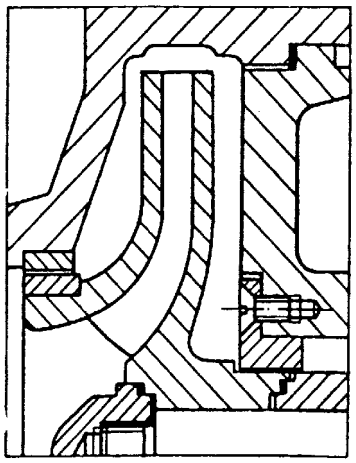
The decision as to version A or B/C depends on the operating conditions.



Version "A"



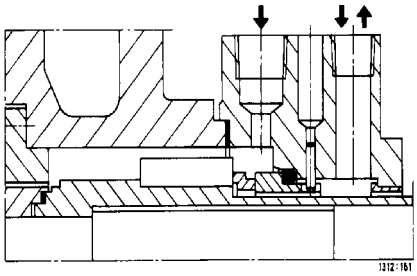
Version "B"



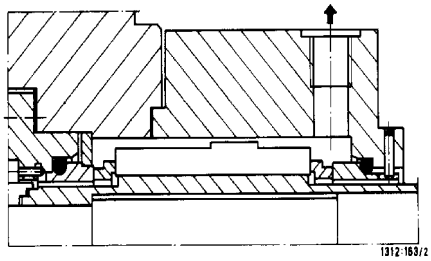
Version "C"

Fig. 4.3.2-1 Balancing types

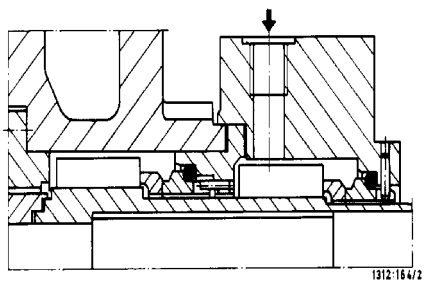
4.3.3 Shaft Seal - Mechanical Seal Arrangement Examples



Single-acting mechanical seal, balanced



Double-acting mechanical seal, both sides balanced



Double-acting mechancial seal, tandem arrangement

4.3.4 Bearings

4.3.4.1 Design Specifications

The shaft is supported by oil-lubricated rolling element bearings. The motor end bearing is a fixed bearing limiting the rotor's axial movement to max. 0.5 mm.

The pump end bearing is a radial bearing which can only absorb the radial load. It is always a cylindrical roller bearing.

The motor end bearing is a paired angular contact ball bearing.

A reinforced version (next bearing size) is available for special operating conditions (P..as).

4.3.4.2 Bearing Bracket Designation

P 03 a s

Back pull-out bearing bracket
Size (refers to the dimensions of sealing chamber and shaft end)
Reinforced (next bearing size)
Paired angular contact ball bearings (motor end)

For the applicable bearing bracket design please refer to the data sheet.

4.3.4.3 Bearings Used / Bearing Design

KSB designation	FAG designation	SKF designation
B.G	B. TVP. UA BUA	BGM BG
B.G 8	BUA 80	BEGP/C 86

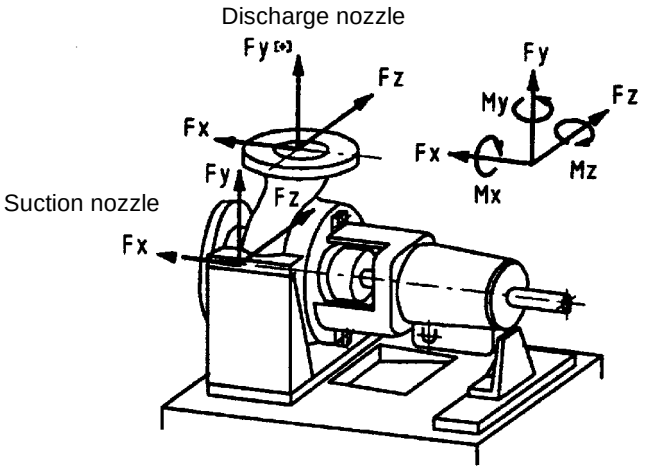
Bearing assembly

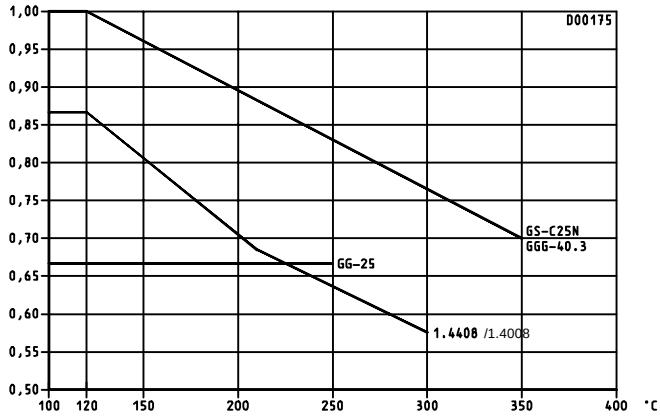
Bearing bracket	Rolling element bearing	
	Pump end	Motor end
P 03 s	NU 307	2 x 7307 BG
P 04 s	NU 311	2 x 7311 BG8
P 05 s	NU 313	2 x 7313 BG8
P 06 s	NU 413	2 x 7315 BG8
P 08 s	NU 416	2 x 7319 BG

Reinforced bearing assembly with reinforced thrust bearing

Bearing bracket	Rolling element bearing	
	Pump end	Motor end
P 02 as	NU 307	2 x 7307 BG
P 03 as	NU 311	2 x 7311 BG8
P 04 as	NU 313	2 x 7313 BG8
P 05 as	NU 413	2 x 7315 BG8
P 06 as	NU 416	2 x 7319 BG

4.3.5 Permissible Forces and Moments at the Pump Nozzles





The forces and moments were determined on the basis of API 610 (6th edition), table 2, doubled values.

The resulting permissible forces have been determined according to

$F_{res\ D} \pm \sqrt{F_x^2 + F_z^2}$ and $F_{res\ S} \pm \sqrt{F_y^2 + F_z^2}$

The data on forces and moments apply to static pipelines only. If the limits are exceeded, they must be checked and verified. If a mathematical strength analysis is required, please contact KSB.
The values are only applicable if the pump is installed on a completely grouted baseplate and bolted to a rigid and even foundation.
If temperatures exceed 120 °C, the values indicated must be reduced in accordance with the above diagram. For materials 1.7706 and 1.4931, no reduction is necessary.

Pump sizes	Forces									Moments					
	Suction nozzle				Discharge nozzle					Suction nozzle in daNm			Discharge nozzle in daNm		
	IN N				IN N					IN Nm			IN Nm		
	F_x	F_y	F_z	F_{res}	F_x	[+] $F_{ytension}$	[-] $F_{ypressure}$	F_z	F_{res}	M_x	M_y	M_z	M_x	M_y	M_z
25-160 -200	1400	900	1140	1500	700	450	900	600	900	750	600	400	500	400	250
40-160 -200 -250 -315	1800	1200	1400	1800	1150	700	1400	900	1500	1050	800	500	750	600	400
50-160 -200 -250 -315 -400	2850	1900	2280	2900	1400	900	1800	1150	1850	1900	1450	1000	1050	800	500
80-160 -200 -250 -315 -400	3600	2300	2850	3700	2300	1400	2850	1900	3000	2650	2000	1350	1900	1450	1000
100-200 -250 -315 -400	6200	4100	5000	6450	2850	1800	3600	2300	3700	4600	3550	2350	2650	2000	1350
150-250 -315 -400 -500	9800	6200	7600	9800	5000	3100	6200	4100	6450	7050	5150	3550	4600	3550	2350
200-250 -315 -400 -401 -501	13350	8900	10700	13900	7600	4700	9800	6200	9800	10050	7600	4900	7050	5150	3550
250-401 -501	16000	10700	13350	17100	10700	6700	13350	8900	13900	12200	9200	6000	10050	7600	4900
300-400 -500	17800	11600	14250	18350	13350	8200	16000	10700	17100	12750	9500	6250	12200	9200	6000
350-400 -500	17800	11600	14250	18350	14250	8900	17800	11600	18350	12750	9500	6250	12750	9500	6250

4.3.6 Noise Characteristics

Rated power input P_N	Sound pressure level L pA (dB) 1)					
	Pump alone			Pump with motor		
(kW)	2900 1/min	1450 1/min	960/760 1/min	2900 1/min	1450 1/min	960/760 1/min
1.5	53.5	52.5	51.5	63.0	58.0	55.5
2.2	55.5	54.5	53.0	66.0	60.0	58.0
3.0	57.0	56.0	54.5	67.5	61.5	59.5
4.0	59.0	57.5	56.0	69.0	63.0	61.0
5.5	60.5	59.0	57.5	70.5	64.5	62.0
7.5	62.0	61.0	59.0	72.0	66.0	63.5
11.0	64.0	63.0	61.0	74.0	67.5	65.0
15.0	66.0	64.5	62.5	75.0	69.0	66.5
18.5	67.0	65.5	63.5	76.0	70.0	67.5
22.0	68.0	66.5	64.5	76.5	70.5	68.0
30.0	70.0	68.0	66.0	78.0	72.0	69.5
37.0	71.0	69.5	67.0	78.5	72.5	70.0
45.0	72.0	70.5	68.0	79.5	73.5	71.0
55.0	73.0	71.5	69.0	80.0	74.0	71.5
75.0	74.5	73.0	70.5	81.0	75.5	72.5
90.0	75.5	74.0	71.0	81.5	76.0	73.0
110.0	77.0	75.0	72.0	82.0	76.5	74.0
132.0	78.0	76.0	73.0	82.5	77.0	74.5
160.0	79.0	77.0	74.0	83.5	78.0	75.0
200.0	80.0	78.0	75.0	84.0	78.5	75.5
250.0	80.5	78.5	-	84.5	79.5	-

1) Measured at a distance of 1 m from the pump outline

4.4 Accessories

Coupling: flexible coupling with / without spacer sleeve
Guard: coupling guard
Baseplate: welded for the complete unit (pump and motor); in torsion-proof design

If a complete unit is supplied, coupling and coupling guard are provided by the supplier.
Special accessories: as required

4.5 Dimensions and Weights

For dimensions and weights please refer to the pump installation plan.

5 Installation at Site

5.1 Safety Regulations

Electrical equipment operated in hazardous locations must comply with the explosion protection regulations. This is indicated on the motor rating plate.

If the equipment is installed in hazardous locations, the applicable local explosion protection regulations and the regulations of the test certificate supplied with the equipment and issued by the responsible approval authorities must be observed and complied with. The test certificate must be kept close to the location of operation for easy access (e.g. foreman's office).

5.2 Checks to be Carried out Prior to Installation

All structural work required must have been prepared in accordance with the dimensions stated in the dimension table / installation plan.

The concrete foundations shall have sufficient strength (min. BN 150) to ensure safe and functional installation in accordance with DIN 1045 or equivalent standards.

Make sure that the concrete foundation has set firmly before placing the unit on it. Its surface should be truly horizontal and even. The foundation bolts should be inserted in the baseplate holes.

5.3 Installing the Pump / Unit

After placing the pump on the foundation, align it with the help of a spirit level placed on the shaft / discharge nozzle. Permissible deviation: 0.2 mm/m. The correct distance between the coupling halves as specified in the installation plan must be observed. Shims should be fitted between the baseplate and the foundation itself; they should always be inserted to the left and right of the foundation bolts and in close proximity to these bolts. For a bolt-to-bolt clearance of more than 800 mm, additional shims should be inserted halfway between the adjoining holes. All shims must lie perfectly flush.

Insert the foundation bolts and set them into the foundation using concrete. When the mortar has set, align the baseplate as described in section 5.3.1 and tighten the foundation bolts evenly and firmly. Then grout the baseplate using low shrinkage concrete with a standard particle size and a water / concrete ratio of ≤ 0.5. The flowability must be produced with the help of a solvent. Secondary treatment of the concrete to DIN 1045 is an absolute necessity.

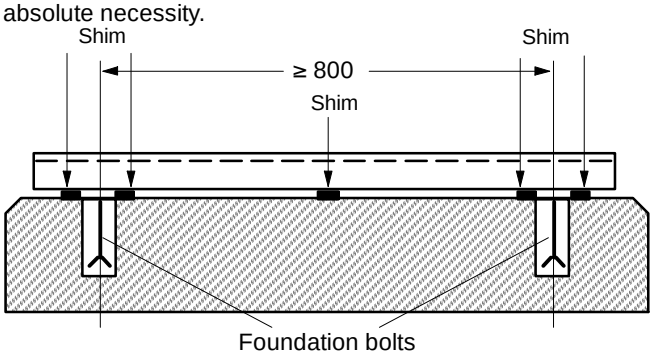


Fig. 5.3-1 Fitting required shims

To ensure low-noise operation, the unit can be mounted on vibration dampers (please confirm with KSB first). Expansion joints can be fitted between pump and suction / discharge line.

5.3.1 Aligning the Pump / Drive

Caution After fastening the baseplate on the foundation and connecting the piping, the coupling must be thoroughly checked and the pump set be realigned (at the motor), if required.

Prior to checking the alignment / realignment, loosen support foot 183 and re-tighten without transmitting any stresses or strains.

Coupling check and realignment must be effected even if pump and motor are supplied completely assembled and aligned on a common baseplate.

The pump set is correctly aligned, if a straight-edge placed axially on both coupling halves is the same distance from each shaft at all points around the circumference. In addition, the distance between the two coupling halves must remain the same all around the circumference. Use a feeler gauge, a wedge gauge or a dial micrometer to verify (see figures 5.3-2 and 5.3-3).

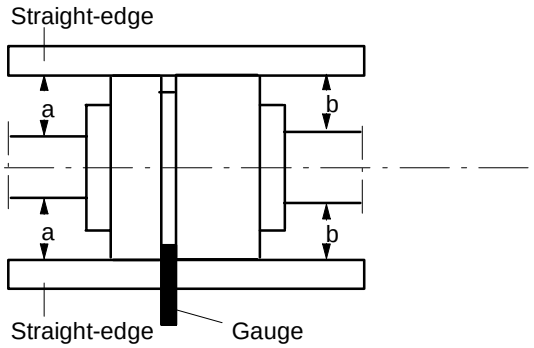


Fig. 5.3-2 Aligning the coupling with the help of a gauge and a straight-edge

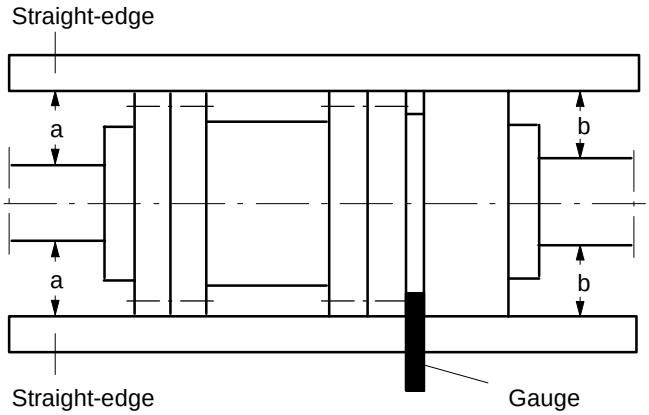


Fig. 5.3-3 Aligning a spacer-type coupling

The radial and axial deviation between the two coupling halves should not exceed 0.1 mm.

Improper alignment of the unit can cause damage to both the coupling and the unit itself!

Also refer to the supplementary operating instructions, if applicable.

5.3.2 Place of Installation

The volute casing and discharge cover take on roughly the same temperature as the medium handled. The discharge cover, bearing bracket and bearing housing must not be insulated.

Take the necessary precautions to avoid burnings.

5.4 Connecting the Piping

Caution Never use the pump itself as an anchorage point for the piping. The permissible pipeline forces must not be exceeded (see section 4.3.5).

Suction lift lines should be laid with a rising slope towards the pump and suction head lines with a downward slope towards the pump. The pipelines should be anchored in close proximity to the pump and should be connected without transmitting any stresses or strains. The nominal diameters of the pipelines should be at least equal to the nominal diameters of the pump nozzles.

It is recommended to install check and shut-off elements in the system, depending on the type of plant and pump. It must be ensured, however, that the pump can still be drained and dismantled without problems.

Thermal expansions of the pipelines must be compensated by appropriate measures so as not to impose any extra loads on the pump exceeding the permissible pipeline forces and moments.

An excessive, impermissible increase in the pipeline forces may cause leaks on the pump where the medium handled can escape into the atmosphere.

Danger of life when toxic or hot media are handled.

The flange covers on the pump suction and discharge nozzles must be removed prior to installation in the piping.

5.4.1 Auxiliary Connections

The dimensions and locations of the auxiliary connections (cooling, heating, sealing liquid, flushing liquid, etc.) are indicated on the installation plan or piping layout.

Caution These connections are required for proper functioning of the pump and are therefore of vital importance!

5.4.2 Coupling Guard

In compliance with the accident prevention regulations the pump must not be operated without a coupling guard. If the customer specifically requests not to include a coupling guard in our delivery, then the operator must supply one.

5.5 Final Check

Re-check the alignment as described in section 5.3.

It must be easy to rotate the shaft by hand at the coupling.

5.6 Connection to Power Supply

Connection to the power supply must be effected by a trained electrician only. Check available mains voltage against the data on the motor rating plate and select appropriate start-up method.

We strongly recommend to use a motor protection device.

VDE 0171/2.61 stipulates that explosion-proof motors, type of protection IP 54, "increased safety" Ex, temperature class T3, must always be connected via a motor protection switch.

6 Commissioning, Start-up / Shutdown

Caution **Compliance with the following requirements is of paramount importance. Damage resulting from non-compliance shall not be covered by the scope of warranty.**

6.1 Commissioning

Before starting up the pump make sure that the following requirements have been checked and fulfilled.

If a constant-level oiler is provided, screw same into the upper tapping hole of the bearing bracket prior to adding the oil (see 6.1.1).

The operating data, the oil level, if required (6.1.1), and the direction of rotation (6.1.4) must have been checked. The pump set must have been primed (6.1.3).

- Make sure that the unit has been properly connected to the electric power supply and is equipped with all protection devices.
- Make sure that all auxiliary lines (5.4.1) are connected and functioning.
- If the pump has been out of service for a longer period of time, proceed in accordance with section 6.4.

6.1.1 Lubricants

Oil-lubricated bearings

The bearing bracket has to be filled with lubricating oil. The quality of oil required is outlined in section 7.2.2.3 and the quantity in section 7.2.2.4.

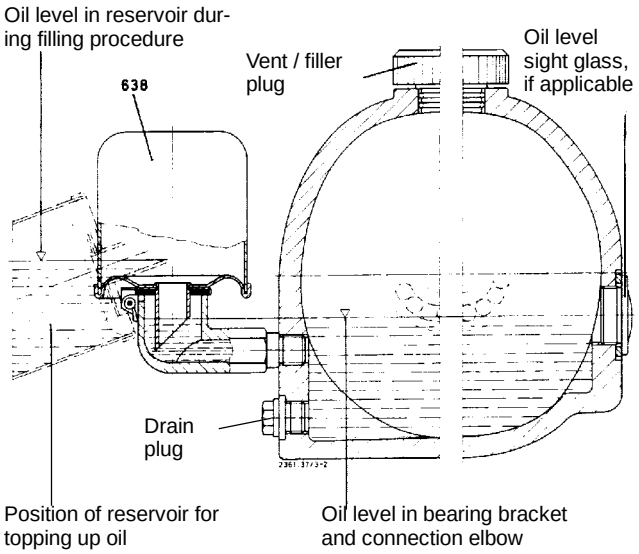


Fig. 6.1-1 Oil fill

Procedure:

Unscrew vent plug. Pour in the oil through the vent plug tapping hole after having hinged down the reservoir of the constant-level oiler until oil appears in the vertical portion of the connection elbow (see Fig. 6.1-1). Then fill the reservoir of the constant-level oiler with oil and snap it back into operating position. Screw vent plug in again. After a short time check whether the oil level in the reservoir has dropped. It is important to keep the reservoir properly filled at all times.

If access to the vent plug is difficult or impossible, e.g. in cases where the motor is arranged above the pump (piggy-back arrangement), the oil can be filled in through the connection elbow of the constant-level oiler.

Caution The oil level should always be below the level of the vent opening arranged at the top edge of the connection elbow. For checking the oil level we recommend to slowly drain oil through the drain plug until the constant-level oiler starts to operate, i.e. until air bubbles can be seen in the oiler.

If no constant-level oiler is provided on the bearing bracket, make sure that the oil level reaches the centreline of the oil level sight glass arranged at the side of the bearing bracket.

6.1.2 Shaft Seal

Caution Mechanical seals are fitted prior to delivery.

On variants with quench supply tank, the tank must be fitted in accordance with the installation plan (see 6.1.3). Quench feed must also be provided during pump shutdown.

On variants with double-acting mechanical seals, apply sealing pressure as specified in the installation plan prior to starting up the pump (see 6.1.3). Sealing pressure must also be provided during pump shutdown.

For external liquid supply, the quantities and pressures specified in the data sheet and installation plan should be applied.

6.1.3 Priming the Pump and Checks to Be Carried out

Before start-up, the pump, the suction line and (if applicable) the thermosiphon tank must be vented and primed. The shut-off element in the suction line must be fully open.

Fully open all auxiliary lines provided (flushing, sealing, cooling liquid, etc.) and check the throughflow.

For water cooling, use suitable non-aggressive cooling water not liable to form deposits and not containing suspended solids. (Hardness: on average 5dH (ca. 1 mmol/l); pH > 8, or conditioned and neutral with regard to mechanical corrosion).

Inlet temperature t_E = 10 to 30 °C
Outlet temperature t_A max. 45 °C

Caution **Dry-running will result in increased wear on the mechanical seal and must be avoided!**

6.1.3.1 Cooling

Caution In general, the shaft seal must be cooled, if the vaporisation pressure of the medium handled exceeds the atmospheric pressure.

Depending on the medium handled, the system pressure and the packing material, the limit may change (example: hot water).

6.1.3.1.1 Cooling of Shaft Seal

Bearing bracket	Cooling liquid quantity in l/min at a temperature of the pumped product of	
	up to 250 °C	up to 400 °C
P 02 as	3	4
P 03 s/as	4	5
P 04 s/as	5	6
P 05 s/as	5	6
P 06 s/as	6	7
P 08 s	7	8

Cooling liquid pressure: max. 10 bar

6.1.3.1.2 Cooling of Heat Exchanger

For mechanical seals with product circulation "PZ" (API plan "I") the following cooling liquid quantities must be provided for the heat exchanger.

n=1/min	Bearing bracket					
	P 02as	P 03as P 03 s	P 04as P 04 s	P 05as P 05 s	P 06as P 06 s	P 08 s
	l/min					
1450	3	4	6	8	10	10
2900	15	15	20	20	30	

Fig. 6.1.3.1.2-1 Cooling liquid quantity in l/min

6.1.3.1.3 Cooling of Bearing Bracket

The bearing temperature is largely unaffected by bearing load and the temperature of the pumped liquid. However, it depends on factors such as pump speed, ambient temperature, oil quality and oil level.

Paired angular ball bearings will always cause higher temperatures than simple grooved ball bearings. When using a 4-pole drive, cooling can be dispensed with. When using a 2-pole drive, bearing brackets P 04 s/as, P 05 s/as and P 06 s/as must be cooled from product temperatures of 200 °C upwards!

Max. pressure of cooling liquid: 10 bar
Quantity of cooling liquid: approx. 3 l/min

6.1.3.1.4 Cooling of Casing Support on the Baseplate

For temperatures above 250 °C and impeller diameters larger than 315 mm, the casing support on the baseplate must be cooled. The cooling system can be series connected with the cooling of the bearing bracket.

Quantity of cooling liquid required for series connection: approx. 5 l/min. For parallel connection, each cooling system requires 3 l/min.

6.1.3.2 Heating

The space between discharge cover and bearing bracket lantern can be used as a heating chamber, if necessary, by feeding hot water, steam or heat transfer oil, especially in connection with internal circulation.

Design	Heating with			
	hot water / saturated steam		heat transfer oil	
	$t_{max.}$ in °C	$p_{max.}$ in bar	$t_{max.}$ in °C	$p_{max.}$ in bar
Normal design; lantern GG, O-ring made of EPR	183	10	-	-
Lantern GGG-40.3, O-ring made of Ekonol	220 250	22.5[1)] 20[1)]	300	6

[1)] From impeller diameter 315 mm upwards, $P_{max.}$ = 10 bar. For higher pressures contact KSB.

Fig. 6.1.3.2-1 Heating

6.1.4 Checking the Direction of Rotation

When the unit has been connected to the electric power supply, verify the following (local and national regulations have to be taken into account separately):

Caution For trouble-free operation of the pump, the correct direction of rotation of the impeller is of paramount importance. If running in the wrong direction of rotation, the pump cannot reach its duty point; vibrations and overheating will be the consequence. The unit or the shaft seal might be damaged.

Correct direction of rotation:

The direction of rotation must correspond to the direction indicated by the arrow on the pump. This can be verified by switching the pump on and then off again immediately.

Before checking the direction of rotation make sure that there is no foreign matter in the pump casing.

Never put your hands or any other objects into the pump.

Caution Do not run the pump without liquid while checking the direction of rotation. If there is no medium handled available, the motor's direction of rotation must be checked with the pump decoupled.

If the pump runs in the wrong direction of rotation, interchange two of the three phases in the control cabinet or motor terminal box.

6.1.5 Cleaning the Plant Piping

The cleaning operation mode and duration for flushing and pickling service must be matched to the casing and seal materials used.

6.1.6 Start-up Strainer

If a start-up strainer has been fitted to protect the pumps against dirt and / or to retain contamination from the plant, the strainer's contamination level must be monitored by measuring the differential pressure so as to ensure adequate inlet pressure for the pump.

For installation and monitoring, see additional instruction sheet.

6.1.7 Start-up

Before starting the pump ensure that the shut-off element in the suction line is fully open. The pump may be started up against a closed discharge-side swing check valve or shut-off element. Only after the pump has reached full rotational speed should the shut-off element be opened slowly and adjusted to comply with the duty point. When starting up against an open discharge-side shut-off element, take the resulting increase in input power into account.

Caution After the operating temperature has been reached and/or in the event of leakage, switch off the unit and re-tighten the bolts between the lantern and the casing.

Caution Check coupling alignment as described in section 5.3.1 after the operating temperature has been reached and re-align, if necessary.

6.1.8 Shutdown

Close the shut-off element in the discharge line.

If the discharge line is equipped with a non-return or check valve, the shut-off element may remain open. If shut-off is not possible, the pump will run in reverse rotation. The reverse runaway speed must be lower than the rated speed.

Switch off the drive, making sure that the unit runs smoothly down to a standstill.

Close the auxiliary lines but only turn off the cooling liquid supply (if applicable) after the pump has cooled down. Please refer to section 6.1.2!

In the event of frost and / or prolonged shutdowns, the pump – and if applicable the cooling chambers – must be drained or otherwise protected against freezing.

6.2 Operating Limits

The pump's / unit's application limits regarding pressure, temperature and speed are stated on the data sheet and must be strictly adhered to.

If a data sheet is not available, contact KSB.

6.2.1 Temperature of the Medium Handled, Ambient Temperature, Bearing Temperature

Caution Do not operate the pump at temperatures exceeding those specified on the data sheet or the name plate unless the written consent of the manufacturer has been obtained.

Damage resulting from disregarding this warning will not be covered by the KSB warranty.

Bearing temperatures as described in section 7.2.1 must be observed.

6.2.2 Switching Frequency

To prevent high temperature increases in the motor and excessive loads on the pump, coupling, motor, seals and bearings, the switching frequency should not exceed the following number of start-ups per hour (S).

Motor rating (kW)	max. S (switchings/h)
up to 12	25
up to 100	20
more than 100	10

6.2.3 Density of the Medium Handled

The power input of the pump will increase in proportion to the density of the medium handled. To avoid overloading of the motor, pump and coupling, the density of the medium must comply with the data specified on the purchase order.

6.2.4 Abrasive Media Handled

When the pump handles liquids containing abrasive substances, increased wear of the hydraulic system and the shaft seal are to be expected. The intervals recommended for servicing and maintenance should be shortened.

6.2.5 Minimum / Maximum Flow

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

Q_{min} = 0.1 x Q_{opt} for short operation
Q_{min} = 0.3 x Q_{opt} for continuous operation
Q_{max} = 1.1 x Q_{opt} for 2-pole operation
Q_{max} = 1.25 x Q_{opt} for 4-pole operation
Q_{opt} = optimum efficiency

6.3 Shutdown / Storage / Preservation

Each KSB pump leaves the factory carefully assembled. If commissioning is to take place some time after delivery, we recommend that the following measures be taken for pump storage.

6.3.1 Storage of New Pumps

- New pumps are supplied by our factory duly prepared for storage.
  Maximum protection for up to 12 months, if the pump is properly stored indoors.
- Store the pump in a dry location.
- Rotate the rotor by hand once a month.

6.3.2 Measures to Be Taken for Prolonged Shutdown

1. **The pump remains installed; periodic check of operation**
   In order to make sure that the pump is always ready for instant start-up and to prevent the formation of deposits within the pump and the pump intake area, start up the pump set regularly once a month or once every 3 months for a short time (approx. 5 minutes) during prolonged shutdown periods. Prior to an operation check run ensure that there is sufficient liquid available for operating the pump.

2. **The pump is removed from the pipe and stored**
   Before putting the pump into storage carry out all checks specified in sections 7.1 to 7.4. Then apply appropriate preservatives:
   - Spray-coat the inside wall of the pump casing, and in particular the impeller clearance areas, with a preservative. Spray the preservative through the suction and discharge nozzles. It is advisable to close the nozzles (for ex. with plastic caps or similar).

6.4 Returning to Service after Storage

Before returning the pump to service carry out all checks and maintenance work specified in sections 7.1 and 7.2.

In addition, the instructions laid down in the sections on "Commissioning" (6.1) and "Operating Limits" (6.2) must be observed.

Upon completion of the work, all safety-related and protective equipment must be properly refitted and / or reactivated before starting the pump set.

7 Maintenance / Repair

7.1 General Instructions

The operator is responsible for ensuring that all maintenance, inspection and installation work is carried out by authorised, duly qualified staff who are thoroughly familiar with these operating instructions.

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

Work on the unit must only be carried out with the electrical connections disconnected. Make sure that the pump set cannot be switched on accidentally (danger of life!).

Pumps handling liquids posing health hazards must be decontaminated. When draining the medium see to it that there is no risk to persons or the environment. All relevant laws must be adhered to (danger of life!).

7.2 Maintenance / Inspection

7.2.1 Supervision of Operation

Caution The pump should run quietly and free from vibrations at all times.

The pump must never be allowed to run dry.

Prolonged operation against a closed shut-off element is not permitted. When running the pump against a closed discharge-side shut-off element for a short period, the permissible pressure and temperature values must not be exceeded.

The bearing temperature may exceed room temperature by up to 50 °C but must never rise above +90 °C.

Verify correct oil level as described in section 6.1.1.

The shut-off elements and the auxiliary feed lines must not be closed during operation.

Any stand-by pumps installed should be switched on and then immediately off again once a week to keep them operational. Attention should be paid to the correct functioning of the auxiliary lines.

The cooling system must be thoroughly cleaned at least once a year to ensure proper cooling. Take the pump out of service for this purpose.

Caution If the flexible coupling elements begin to show signs of wear, they should be replaced in due time.

7.2.2 Lubrication and Lubricant Change

7.2.2.1 Lubrication

The rolling element bearings are lubricated with mineral oil. The lubricant change intervals as well as the required quantity and quality are specified below.

7.2.2.2 Oil Change (Operating Hours)

Temperature at the bearing	First oil change after	All subsequent oil changes after every
≤ + 50 °C	300 operating hours	3000 operating hours[1)]
> + 50 °C	300 operating hours	2100 operating hours[1)]

1) at least once a year

Fig. 7.2-1

Procedure:
Remove screwed plug below the constant-level oiler (oil level sight glass) and drain off the oil. After drainage of the bearing bracket, screw in the plug again and fill with fresh oil as described in section 6.1.1.

Caution Please observe the local laws applicable to disposal of such substances.

7.2.2.3 Oil Quality

Designation	Lubricating oil C 46 DIN 51 517 or HD 20 W / 20 SAE
Symbol to DIN 51 502	V
Analysis	
Kinematic viscosity at 40 °C	min. 41.1 x 10^{-6} max. 50.8 x 10^{-6} $\frac{mm^2}{s}$
Flash point (to Cleveland)	+ 175 °C
Solidification point (pour point)	- 15 °C
Application temperature [1)]	higher than permissible bearing temperature

1) For temperatures below 0 °C another suitable lubricating oil type must be used. Please contact KSB.

7.2.2.4 Oil Quantity

Bearing bracket	Oil quantity in l
P 02 as	0.3
P 03 s, P 03 as	0.5
P 04 s, P 04 as	0.5
P 05 as	1.2
P 06 as	1.4
P 05 s	1.5
P 06 s	1.8
P 08 s	4.5

7.3 Drainage / Disposal

Caution If the pump was used for handling liquids posing health hazards, see to it that there is no risk to persons or the environment when draining the medium. All relevant laws must be heeded. If required, wear safety clothing and a protective mask.

If the media handled by the pumps leave residues which might lead to corrosion when coming into contact with atmospheric humidity, or which might ignite when coming into contact with oxygen, then the unit must be flushed through, neutralised, and then for drying purposes anhydrous gas should be blown through the pump.

Use connections 6B to drain the pump set.

The flushing liquid used and any liquid residues in the pump must be properly collected and disposed of without posing any risk to persons or the environment.

7.4 Dismantling

⚠ Before dismantling, secure the pump so as to make sure it cannot be switched on accidentally. The shut-off elements in the suction and discharge lines must be closed.

The pump must have cooled down to ambient temperature, it must be drained and its pressure must be released.

Dismantling and reassembly must always be carried out in accordance with the relevant sectional drawing.

7.4.1 Fundamental Instructions and Recommendations

Repair and maintenance work to the pump must only be carried out by specially trained personnel, using **original spare parts** (see 2.7).

Observe the safety regulations laid down in section 7.1.

Any work on the motor shall be governed by the specifications and regulations of the respective motor supplier.

Dismantling and reassembly must always be carried out in accordance with the relevant general drawing. The general drawing and other relevant documents are found in the annex. The dismantling sequence can be derived from the general drawing. In case of damage you can always contact our service departments.

7.4.2 Dismantling (General)

1. Drain the oil as described in 7.2.2.2.
2. Remove the coupling guard.
3. Dismantle the coupling spacer sleeve or, if not applicable, remove the drive.
   If required, refer to the additional sheet on couplings.
4. Disconnect and remove all auxiliary pipework.
5. Loop a rope tightly around the top stay of bearing bracket lantern 344.
6. Unscrew hexagon head bolt 901.04 and baseplate fixing bolts on support foot 183; remove the support foot.
7. Unscrew hexagon nuts 920.01 and pull complete bearing bracket 330 out of volute casing 102 together with shaft 210, impeller 230, and bearing bracket lantern 344 using forcing screws 901.31. Clean the screw threads beforehand.
8. Undo impeller nut 922 with Heli-Coil insert (right-handed screw thread) and remove joint ring 411.31. Pull off impeller 230 with a pull-off device and remove key 940.01.
9. Remove hexagon nuts 920.02 and push back seal cover 471.01 until it abuts against thrower 507.01. Take off casing cover 161 and remove joint ring 411.11 and O-ring 412.01. Undo screws 900.04 and remove neck bush 456.01.
10. Pull the complete mechanical seal assembly with shaft protecting sleeve 524.01, joint ring 411.32, seal cover 471.01, joint ring 411.15 and thrower 507.01 off the shaft. For dismantling of mechanical seal please refer to the supplementary sheet.
11. Unscrew hexagon nuts 920.04 and remove bearing bracket lantern 344.
12. After having unscrewed the socket head cap screw in the coupling hub, pull the coupling half off the pump shaft using a pull-off device and remove key 940.02.
13. Undo socket head cap screws 914.01/.02 and take off the pump end and motor end bearing covers 360.01 and 360.02 with gaskets 400.01/.02.
14. Carefully drive shaft 210 together with rolling element bearing 320.02 and the inner race of radial roller bearing 322.01 out of the bearing bracket towards the drive end.
15. Remove support disc 550.23. Inspect condition of circlips 932.01/.02. Remove radial roller bearing 322.01 (roller cage) from the bearing bracket.
16. Bend back lockwasher 931.01, unscrew keywayed nut 920.21 (right-handed screw thread) and remove lockwasher 931.01.
17. Heat up rolling element bearing 320.02 and the inner race of radial roller bearing 322.01 and pull them off the shaft.
18. Clean all the components and examine them for signs of wear. Touch up the damaged components or replace them by new ones.

7.5 Reassembly

7.5.1 General Instructions

The pump should be reassembled in accordance with the rules of sound engineering practice.

Clean all dismantled components and check them for signs of wear. Damaged or worn components are to be replaced by **original spare parts**. Make sure that the seal faces are clean and that gaskets are properly fitted.

It is recommended to use new seal elements (O-rings / gaskets) whenever the pump is reassembled. Make sure that new gaskets have the same thickness as the old ones.

Gaskets made of graphite or other asbestos-free material must always be fitted without using lubricants such as copper grease or graphite paste.

Avoid the use of mounting aids as far as possible. Should a mounting aid be required after all, use a commercially available contact adhesive (e.g. Pattex). The adhesive should only be applied at selected points (3 to 4 spots) and in thin layers. Do not use cyanoacrylate adhesives (quick-setting adhesives).

If in certain cases mounting aids or anti-adhesives other than described herein are required, please contact the sealing material manufacturer.

Caution **All graphite gaskets must only be used once!** Never use O-rings that have been glued together from material sold by the metre.

Caution Do not coat O-rings with graphite or similar products. Use animal fats or silicone-base or PTFE-base lubricants instead.

The locating surfaces of the individual components should be coated with graphite or similar before reassembly. The same applies to screwed connections.

7.5.2 Reassembly (General)

Reassembly is effected in reverse order to dismantling. Use the general drawing and the list of components for orientation.

All screws and bolts must be properly tightened during assembly. For the required torques please refer to sections 7.5.3.1 and 7.5.3.2.

1. Use only the bearing types and sizes specified in section 4.3.4. Angular contact ball bearing 320.02 and the inner race of cylindrical roller bearing 322.01 must be heated up in an oil bath to approx. 80 °C before slipping them onto the shaft until they abut against the shaft shoulder.
   Caution The angular contact ball bearings 320.02 must be installed in 'O' arrangement!
   Angular contact ball bearings installed in pairs must always be from the same manufacturer.
   After having mounted angular contact ball bearings 320.02, screw on and tighten keywayed nut 920.21 using a C-wrench and without fitting lockwasher 931.01. Let the ball bearing cool down to approx. 5 °C above ambient temperature.
   Re-tighten the keywayed nut, then unscrew it again. Put a few spots of Molykote on the contact faces of the lockwasher and of the keywayed nut, slip on lockwasher, firmly tighten the keywayed nut and bend over the lockwasher.
2. For mounting the mechanical seal, please refer to the supplementary sheet and observe the instructions in section 7.5.4.
3. Check the sliding fit of the shaft protecting sleeve on the shaft.
4. Carefully insert the impeller joint ring, making sure the ring and sealing surfaces are clean.
5. After installation in the pump casing which has remained in the piping, the coupling alignment should be checked as described in section 5.3.1.
6. Fill in oil as described in section 6.1.1

7.5.3 Tightening Torques

7.5.3.1 Tightening Torques of the Impeller Nut

Impeller nut 922 should be tightened with the following torques:

Bearing bracket	Tightening torque (Nm)	Wrench size (mm)
P 02as	55	22
P 03s, P 03as	125	27
P 04s, P 04as	200	32
P 05s, P 05as	300	41
P 06s, P 06as	520	55
P 08s	1000	60

The impeller nut should be re-tightened some 20 to 30 minutes after installation.

7.5.3.2 Tightening Torques for Screwed Connections

The screwed connections (part No. 902.01/920.01) between volute casing and bearing bracket lantern shall be tightened using a torque wrench.

Only use the torques given in the table. These values are determined on the basis of a friction coefficient $\mu = 0.12$[1)].

Max. permissible tightening torques[2)] in Nm for studs to DIN 938/939 with hexagon nuts to DIN 934.

Material stud / hex. nut	1.7709.05/1.7258.05			Monix 3k/Monix 3k		
Stamp mark on stud / hex. nut	GA / G			MM / MM (M3k)		
	Tightening torques (Nm)					
	1)	2)		1)	2)	
Thread		- 15%	- 20%		- 15%	- 20%
M 10	47	39.9	37.6	-	-	-
M 12	80	68.0	64.0	130	110.5	104.0
M 16	190	161.5	152.0	320	272.0	256.0
M 20	330	280.5	264.0	620	572.0	496.0

1) Applicable to the initial tightening of brand-new threads.
2) After repeated tightening of the threads and in case of good lubrication the values should be reduced by 15 to 20 %

The values given in the table do not apply if general drawings or other instructions state different values.

Caution Re-tighten the above connections 24 hours after assembly using the torques indicated.

7.5.4 Mounting the Mechanical Seal

The following rules must be observed when mounting the mechanical seal:

Extreme care and cleanliness during assembly are of overriding importance for trouble-free operation of the mechanical seal.

The protective wrapping of the contact faces should only be removed immediately before assembly takes place.

After inserting the seat ring, check whether it is plane-parallel in relation to the casing part.

The surface of the shaft protecting sleeve must be absolutely clean and smooth, and the sleeve's mounting edge must be chamfered.

When sliding the rotating unit onto the shaft protecting sleeve, take appropriate steps to protect the shaft protecting sleeve's surface from damage.

On pumps with double-acting mechanical seal the mechanical seal chamber must be properly vented and the required pressure specified in the installation plan must be applied (also during standstill).

Quench liquid supply must also be ensured during pump standstill.

Refer to the supplementary operating instructions, if applicable.

7.5.5 Diametral Clearances between Impeller and Casing / Casing Wear Ring

The clearance gaps refer to the diameter!

Pump size	Group 1	Group 2	Group 3
25 - 160 up to 40 - 200	0.4 + 0.1	0.5 + 0.1	0.6 + 0.1
40 - 250 up to 100 - 315	0.5 + 0.1	0.6 + 0.1	0.7 + 0.1
100 - 400 up to 200 - 501 and 250 - 501	0.6 + 0.1	0.7 + 0.1	0.85 + 0.15
250 - 401 and 300 - 400 and 350 - 500	0.75 + 0.15	0.85 + 0.15	0.95 + 0.15

Fig. 7.5.5-1 Clearance gaps

Clearance gaps to group 2 shall be applied when equivalent, unhardened and non- surface-protected materials (e.g. Monel / Monel) are used for impeller and casing wear rings.

Clearance gaps to group 3 shall be provided for temperatures above 200 °C if impeller or impeller wear rings are made of the following materials:

Impeller	Impeller wear ring	Impeller	Impeller wear ring
1.4408	1.4571	1.4550	1.4552
1.4580	1.4581	9.4306	1.4308

7.6 Spare Parts Stock

When ordering spare parts please always quote the following data stated on the pump name plate:

Type series: here: RPK
Pump size:
Works No.:

7.6.1 Recommended Spare Parts Stock for 2 Years' Operation to VDMA 24 296

Part No.	Part designation	Number of pumps (including stand-by pumps)						
		2	3	4	5	6	8	10 and more
		Quantity of spare parts						
210	Shaft	1	1	2	2	2	3	30 %
230	Impeller	1	1	1	2	2	3	30 %
320.02	Angular contact ball bearing	1	1	2	2	3	4	50 %
322.01	Cylindrical roller bearing	1	1	2	2	3	4	50 %
330	Bearing bracket (cpl. with shaft and bearings)	-	-	-	-	-	1	2 off
433.01	Mechanical seal spring-loaded ring	2	3	4	4	4	6	90 %
	seal seat ring	2	3	4	4	4	6	90 %
	O-rings	2	3	6	8	8	10	150 %
	secondary seals at the stationary spring-loaded ring	2	3	6	8	8	10	150 %
	spring	1	1	1	1	2	2	20 %
456.01 1)	Neck bush	1	1	2	2	2	3	30 %
502.01/.02 1)	Casing wear ring	2	2	2	3	3	4	50 %
503.01/.02 1)	Impeller wear ring	2	2	2	3	3	4	50 %
524.01	Shaft protecting sleeve	1	1	1	2	2	2	20 %
	Gaskets for volute casing (set)	4	6	8	8	9	12	150 %
	Other sealing elements (set)	4	6	8	8	9	12	150 %

1) if fitted

Fig. 7.6.1-1

7.6.2 Interchangeability of Pump Components

Bearing bracket	Pump size	Part designation	Volute casing 2) D	Casing cover	Support foot	Shaft	Inducer 2) D	Impeller 2) D	Angular contact ball bearing 6)	Cylindrical roller bearing	Bearing bracket	Bearing bracket lantern	Mechanical seal	Neck bush	Casing wear ring 1) 3)		Impeller wear ring 1) 3)		Thrower 4)		Shaft protecting sleeve	Impeller nut
		Part No.	102	161	183	210	23-2	230	320.02	322.01	330	344	433.01	456.01	502.01	502.02	503.01	503.02	507.01	507.02	524.01	922
P 02 as	25-160 3)			1	1	1			1	1	1	1	1	1	1		1		1	1	1	1
	40-160 3)			1	1	1			1	1	1	1	1	1	2		2		1	1	1	1
	50-160 3)			1	1	1			1	1	1	1	1	1	3		3		1	1	1	1
	25-200 3)			2	1	1			1	1	1	2	1	1	1		1		1	1	1	1
	40-200 3)			2	1	1			1	1	1	2	1	1	2		2		1	1	1	1
	50-200 3)			2	1	1			1	1	1	2	1	1	3		3		1	1	1	1
P 03 s	80-160 3)			D	2	2			1	1	2	D	2	2	D		D		2	2	2	2
P 03 as	80-200 1)			D	2	2			1	1	2	4	2	2	5	5	5	5	2	2	2	2
	100-200 1)			D	3	2			1	1	2	4	2	2	6	6	6	6	2	2	2	2
	40-250 3)			6	4	2			1	1	2	5	2	2	D		D		2	2	2	2
	50-250 3)			6	2	2			1	1	2	5	2	2	8		8		2	2	2	2
	80-250 1)			D	3	2			1	1	2	5	2	2	3	D	9	9	2	2	2	2
	40-315			8	2	2			1	1	2	6	2	2	11	D	11	D	2	2	2	2
	50-315			8	3	2			1	1	2	6	2	2	11	8	11	8	2	2	2	2
P 04 s	100-250 1)			D	3	3			2	2	3	5	3	3	12	12	D	D	3	3	3	3
P 04 as	150-250 1)			D	4	3			2	2	3	5	3	3	13	13	D	D	3	3	3	3
	80-315 1)			D	3	3			2	2	3	6	3	3	14	14	D	D	3	3	3	3
	100-315 1)			D	4	3			2	2	3	6	3	3	6	6	D	D	3	3	3	3
	50-400 5)			D	4	3			2	2	3	D	3	3	D	D	9	11	3	3	3	3
P 05 s	200-250 1)			D	5	4			3	3	4	D	4	D	17	17	16	16	4	4	4	4
P 05 as	150-315 1)			D	5	4			3	3	4	9	4	5	18	18	17	17	4	4	4	4
	80-400 1)			D	5	4			3	3	4	10	4	5	12	12	D	D	4	4	4	4
	100-400 1)			D	5	4			3	3	4	10	4	5	6	6	6	6	4	4	4	4
	150-400			D	5	4			3	3	4	10	4	5	17	18	16	17	4	4	4	4
P 05 s/as	150-501			D	6	4			3	3	4	11	4	5	D	D	D	D	4	4	4	4
P 06 s	200-315			D	5	5			4	4	5	9	5	6	21	20	21	20	5	5	5	5
P 06 as	200-400			D	5	5			4	4	5	10	5	6	21	20	21	20	5	5	5	5
	200-401 1)			D	6	5			4	4	5	10	5	6	21	21	21	21	5	5	5	5
	250-401 1)			D	6	5			4	4	5	10	5	6	22	22	22	22	5	5	5	5
	200-501 1)			D	6	5			4	4	5	11	5	6	D	D	D	D	5	5	5	5
	250-501 1)			D	7	5			4	4	5	11	5	6	D	D	D	D	5	5	5	5
P 08 s	300-400 1)			D	7	6			5	5	6	12	6	7	22	22	22	22	6	6	6	6
P 08 as	350-400			D	8	D			5	5	6	12	6	7	D	26	D	26	6	6	6	6
	300-500 1)			D	8	6			5	5	6	13	6	7	D	D	D	D	6	6	6	6
	350-500 1)			D	D	6			5	5	6	13	6	7	26	26	26	26	6	6	6	6

1) The dimensions of suction and discharge side casing wear rings and impeller wear rings are identical.
2) Parts cannot be used in other pump sizes.
3) Always supplied without discharge side casing and impeller wear ring.
4) Parts 507.01/02 not interchangeable.
5) Inducer part no. 171 only available in this size
6) See section 4.3.4

Parts with the same number in one column are interchangeable.

Fig. 7.6.2-1 Interchangeability of pump components

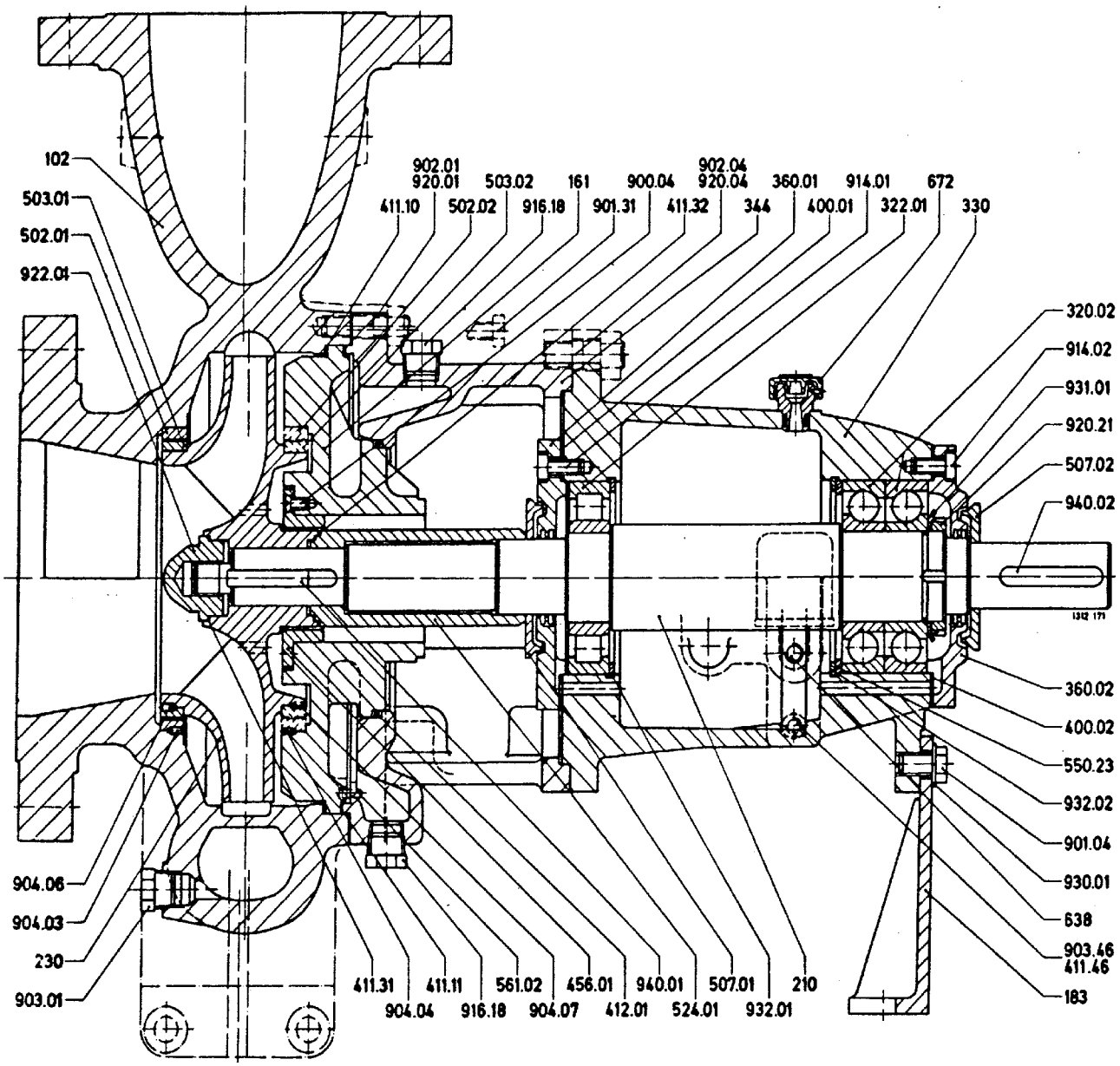
D Symbol for non-interchangeable parts

8 Trouble-shooting

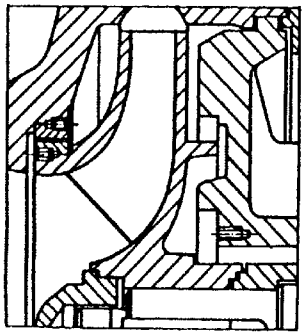
Pump delivers insufficient flow rate	Motor is overloaded	Excessive pump discharge pressure	Increase in bearing temperature	Leakage at the pump	Excessive leakage at the shaft seal	Vibrations during pump operation	Excessive rise of temperature inside the pump	Cause	Remedy [1]
●								Pump delivers against an excessively high discharge pressure.	Re-adjust duty point.
●								Excessively high back pressure.	Check plant for impurities. Increase the speed (turbine, I.C. engine).
●						●	●	Pump or piping are not completely vented or primed.	Vent and / or prime.
●								Supply line or impeller clogged.	Remove deposits in the pump and / or piping.
●								Formation of air pockets in the piping.	Alter piping layout. Fit a vent valve.
			●		●	●		Pump is warped or sympathetic vibrations in piping.	Check pipeline connections and secure fixing of pump; if required, reduce the distances between the pipe clamps. Fix the pipelines using anti-vibration material.
●						●	●	Suction head is too high/$_{NPSH}$ available (positive suction head) is too low.	Check / alter liquid level. Fully open shut-off valve in the suction head line. Change suction line, if the friction losses in the suction line are too high. Check any strainers installed / suction opening. Observe permissible speed of pressure fall.
			●					Increased axial thrust.[2]	Correct rotor adjustment.
●								Air intake at the shaft seal.	Fit new shaft seal.
●								Reverse rotation.	Interchange two of the phases of the power supply cable.
●	●							Motor is running on two phases only.	Replace the defective fuse. Check the electric cable connections.
●								Speed is too low.[2]	Increase speed.
						●		Defective bearings.	Fit new bearings.
			●			●	●	Insufficient rate of flow.	Increase the minimum rate of flow.
●						●		Wear of internal pump parts.	Replace worn components by new ones.
	●					●		Pump back pressure is lower than specified in the purchase order.	Adjust duty point accurately.
	●							Density or viscosity of the fluid pumped is higher than stated in the purchase order.	2)
					●			Use of unsuitable materials.	Change the material combination.
	●	●						Speed is too high.	Reduce the speed.[2]
				●				Tie bolts / seals and gaskets.	Tighten the bolts. Fit new seals and gaskets.
					●			Worn shaft seal.	Fit new shaft seal.
●					●			Score marks or roughness on shaft protecting sleeve.	Fit new shaft protecting sleeve. Fit new shaft seal / check the balancing line. Check throttling bush / throttling sleeve clearances.
					●			Lack of cooling liquid or dirty cooling chamber.	Increase cooling liquid quantity. Clean out cooling chamber. Purify / clean cooling liquid.
					●			Vibrations during pump operation.	Improve suction conditions. Re-align the pump. Re-balance the impeller. Increase the pressure at the pump suction nozzle.
			●		●	●		The unit is misaligned.	Check the coupling; re-align, if required.
			●					Insufficient or excessive quantity of lubricant or unsuitable lubricant.	Top up, reduce or change lubricant.
			●					Non-compliance with specified coupling distance.	Correct distance according to the installation plan.
	●							Operating voltage is too low.	Increase the voltage.
						●		Rotor is out of balance.	Clean the impeller. Re-balance the impeller.

1) The pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.
2) Contact KSB.

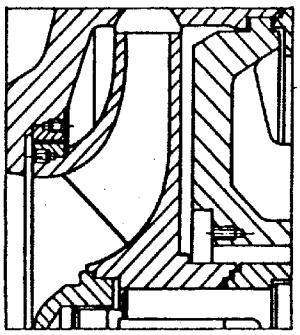
9 General Drawing with List of Components



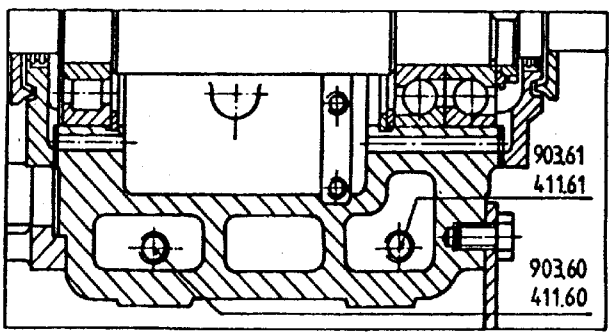
Balancing type ”A”
Uncooled bearing bracket



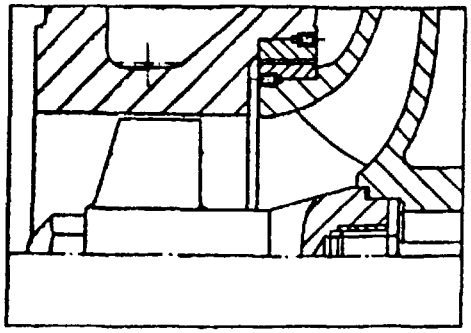
Balancing type ”B”



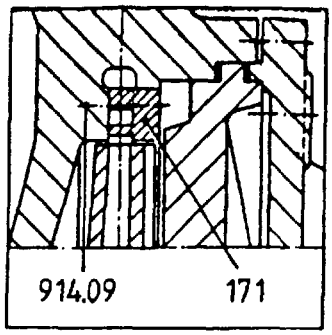
Balancing type ”C”



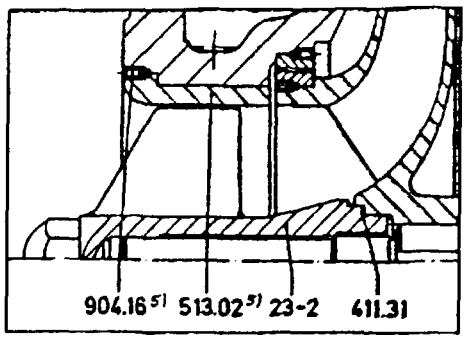
Cooled bearing bracket



RPKI (design for pumps with bearing bracket P 03s)



Pump size 50-400 with inducer



RPKI (design for pumps with bearing brackets P 04s, P 05s, P 06s, P 08s)
5) not on RPK 80-315, 80-400, 100-400

When ordering spare parts please always specify the type series / pump size (stamped on the name plate and on the suction nozzle flange), motor no. (serial no.), year of construction, quantity required, part No., part designation, material, medium handled, sectional drawing No. and mode of dispatch.

Part No.	Part designation	Scope of supply
102	Volute casing[2]	with joint ring 411.10, casing wear ring 502.01, insert ring 513.02[5], studs 902.01, plug 903.01, grub screw 904.03/.16[5], hexagon nut 920.01
161	Casing cover	with joint ring 411.10/.11, O-ring 412.01, casing wear ring 502.02[1], grub screw 904.04[1]
183	Support foot	with hexagon head bolt 901.04, circlip 930.01
210	Shaft	with thrower 507.01/.02, impeller nut 922.01[3], keywayed nut 920.21, lockwasher 931.01, key 940.01/.02
230	Impeller	with joint ring 411.31/.32, impeller wear ring 503.01/.02[1], grub screw 904.06/.07[1]
23-2	Auxiliary impeller (Inducer)[4]	with joint ring 411.31
320.02	Angular contact ball bearing	
322.01	Cylindrical roller bearing	
330	Bearing bracket	with vent plug 672
330	Bearing bracket (complete)	same as above, with support foot 183, bearing cover 360.01/.02, gasket 400.01/.02, joint ring 411.46, disc 550.23, constant level oiler 638, hexagon head bolt 901.04, screwed plug 903.46, screwed plug 903.60/.61[6], joint ring 411.60/.61[6], socket head cap screw 914.01/.02, circlip 932.01/.02
344	Bearing bracket lantern	with joint ring 411.11, O-ring 412.01, grooved pin 561.02, hexagon head bolt 901.31, stud 902.04, plug 916.18, hexagon nut 920.04
360.01/.02	Bearing cover	with gasket 400.01/.02, socket head cap screw 914.01/.02
456.01	Neck bush	with countersunk screw 900.04
502.01/.02[1]	Casing wear ring	with grub screw 904.03/.04
503.01/.02[1]	Impeller wear ring	with grub screw 904.06/.07
524.01	Shaft protecting sleeve	with joint ring 411.32
638	Constant level oiler	

1) can be omitted under certain operating conditions
2) pump size 50-400 with inducer
3) omitted on RPKI
4) only on RPKI
5) only on RPKI from bearing bracket P 04 upwards
6) omitted on uncooled version

1.3.1995 BDF

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