

Works N° (OP): _____

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-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 instruction 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 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 nameplate 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:



Sign of general risk according to ISO 7000-0434.

The electrical danger warning sign is



Symbol of security according to IEC 417 - 5036

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 jeopardize 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 claim 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.)
- Any components in contact with the pumped product, especially in the case of abrasive products, shall be inspected for wear at regular intervals and replaced by original spare parts (see section 2.7) in due time.

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 authorized, 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 have been 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 Unauthorized 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

The warranty relating to the operational reliability and safety of the pump / unit supplied is only valid if the machine is used 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!

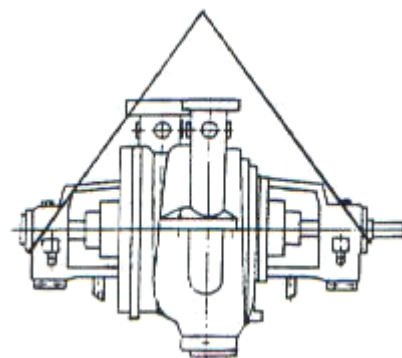


Fig. 3.1-1 Transport of the pump

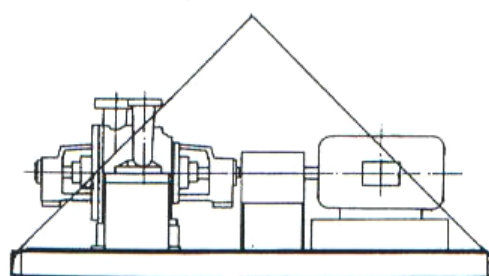


Fig. 3.1-2 Transport of the complete unit

3.2 Interim storage (indoors) / Preservation

When the unit is temporarily put into storage, only the wetted low alloy components (e.g. A48CL30, A536 60-40-18, A216WCB, 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.

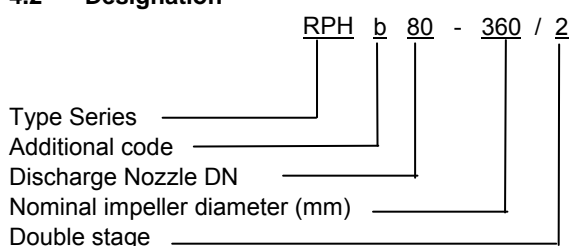
All blank parts and surfaces of the pump are oiled or greased (silicone-free oil and grease) to protect them against corrosion.

4. Description of the product and accessories

4.1 Technical specification

RPHb pumps are above all used for handling the large variety of crude oil products, mainly in refineries and chemical and petrochemical plants.

4.2 Designation



4.3 Design details

Horizontal radially split volute casing pumps in back pull-out design in accordance with API 610 and ISO 9905, with radial impellers, single-flow, double-stage, between bearings design, centerline feet.

4.3.1 Pump casing

Radially split, consisting of volute casing and casing cover with casing wear ring and diffuser plate. The volute casing, the diffuser plate, the casing cover and the stuffing box housings form the internal pump chamber. The wall thickness of the casing includes a corrosion allowance of 1/8" (approx. 3.2 mm).

The stuffing box housings include the heating or cooling chamber for the shaft seal, as required.

4.3.1.1 Pump feet

Generally centerline pump feet.

Centerline pump feet are specified by API 610 for product temperatures $\geq 150^{\circ}\text{C}$.

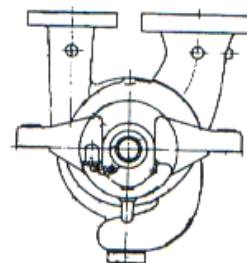


Fig. 4.3-1: Casing with centreline pump feet

4.3.1.2 Nozzle position

Radial inlet nozzle pointing vertically upwards, tangential discharge nozzle pointing vertically upwards (top / top).

4.3.2 Impeller

Closed radial impeller. Impellers are supplied with wear rings on the suction side.

Wear rings are locked with grub screws.

(Can also be locked with three weld points)

Balancing

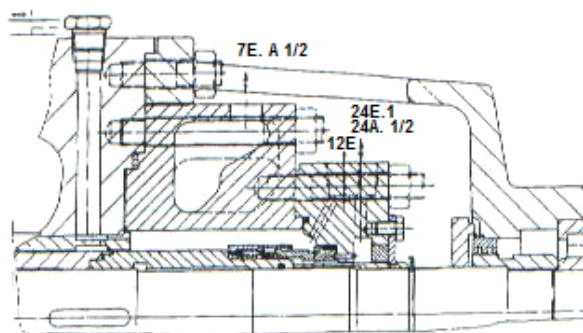
Axial thrust is balanced by the contrarotating movement of the impellers.

4.3.3 Shaft seal – Mechanical seal



Other seal configurations and types may only be used in exceptional cases and after consultation with KSB.

Arrangement examples



Single-acting, balanced, with multiple spring arrangement
J.Crane 881 with A-type seat
J.Crane 1098 with A-type seat (mechanical seal sealed off by wedge ring) in cartridge design.

Fig. 4.3-2 Cooled shaft seal

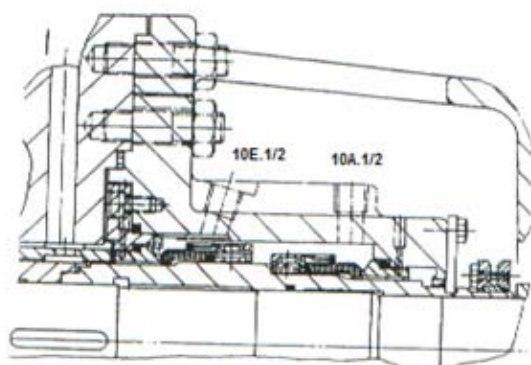


Fig. 4.3-3 Double-acting mechanical seal (Back to Back), both sides balanced / uncooled shaft seal

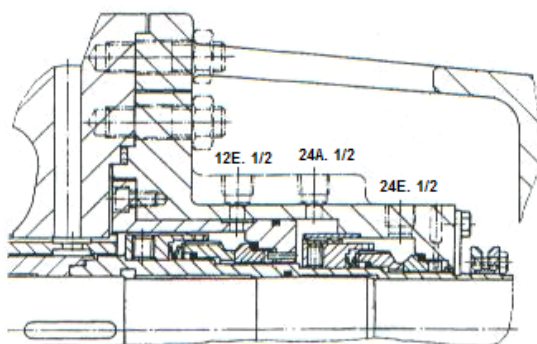


Fig. 4.3-4 TANDEM design / uncooled shaft seal

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 radial bearing. The standard pump end bearing is a paired angular contact ball bearing whose axial bearing clearance limits the axial movement of the rotor.

The bearing brackets are provided with forced oil lubrication. On the standard pump design, the bearing bracket is uncooled. A cooled bearing bracket is available as special pump design. During pump standstill the oil level can be checked at the oil level sight glass.

4.3.4.2 Bearing bracket designation

Back pull-out bearing bracket. D01 or D02.
D01 – RPHb 50-315/2, 80-315/2, 80-360/2
D02 – RPHb 150-350/2

4.3.4.3 Bearings used / Bearing design

| KSB designation | FAG designation | SKF designation |
|-----------------|-----------------|-----------------|
| B.G | B.TVP.UA BUA | BGM BG |

Standard bearings

| Rolling element bearings | | |
|--------------------------|-------------|-----------|
| Bearing bracket | Pump end | Motor end |
| D01 | 2 x 7309 BG | NU 310 |
| D02 | 2 X 7311 BG | NU 311 |

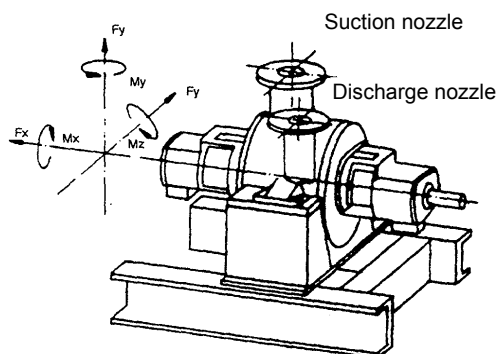
4.3.5 Permissible forces and moments at the pump nozzles

RPHb pumps are designed in such a way that they can withstand higher piping forces and moments than required by API 610, table 4.

The data on forces and moments apply to static pipelines only. If the limits are exceeded, they must be checked and verified. If a computerized 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 level foundation.

Forces and moments of RPHb



| Pump sizes | Suction nozzle | | | | | | Discharge nozzle | | | | | |
|------------|----------------|----------------|----------------|----------------|----------------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|
| | Forces (in N) | | | Moments (Nm) | | | Forces (in N) | | | Moments (Nm) | | |
| | F _x | F _y | F _z | M _x | M _y | M _z | F _x | F _y | F _z | M _x | M _y | M _z |
| 50-315/2 | 2640 | 3240 | 2160 | 2280 | 1720 | 1140 | 1800 | 2160 | 1440 | 1100 | 850 | 550 |
| 80-315/2 | 3480 | 4320 | 2880 | 3200 | 2400 | 1620 | 2640 | 3240 | 2160 | 2280 | 1720 | 1140 |
| 80-360/2 | | | | | | | | | | | | |
| 150-350/2 | 7560 | 9790 | 6230 | 7050 | 5150 | 3520 | 4980 | 6220 | 4100 | 4610 | 3520 | 2360 |

Fig. 4.3-5 Forces and moments

4.3.6 Noise characteristics

| Rated power input P _N (kW) | Sound pressure level L _{pA} (dB) 1) | | | | | |
|---|--|---------------|------------------|-----------------|---------------|------------------|
| | Pump only | | | Pump with motor | | |
| | 2900 1/min | 1450 1/min | 960/760 1/min | 2900 1/min | 1450 1/min | 960/760 1/min |
| 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 | - |
| 315.0 | 80.5 | 78.5 | - | 84.5 | 79.5 | - |
| 355.0 | 80.5 | 78.5 | - | 84.5 | 79.5 | - |
| 400.0 | 80.5 | 78.5 | - | 84.5 | 79.5 | - |
| 500.0 | 80.5 | 78.5 | - | 84.5 | 79.5 | - |

- 1) Measured at a distance of 1 m from the pump outline (as per DIN 45635 Part 1 and 24). Room and foundation influences have not been included. The tolerance for these factors is 1 to 2 dB.
- 2) Increase for 60 Hz operation.
Pump without motor: - - -
Pump with motor:
3500min⁻¹: +3dB, 1750min⁻¹: + 1dB, 1160min⁻¹: ---dB

4.4 Accessories

| | |
|----------------|---|
| Coupling: | flexible spacer-type coupling |
| Contact guard: | coupling guard |
| Baseplate: | welded for the complete unit (pump and motor); in torsion-resistant 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 must be truly horizontal and even. The foundation bolts must be inserted in the baseplate holes.

5.3 Installing the pump / unit

| | |
|---|---------------------------|
| 1 | Bolt-to-bolt clearance |
| 2 | Shim |
| 3 | Shim if clearance >800 mm |
| 4 | Foundation bolt |

- The foundation has the required strength and characteristics.
- The foundation has been prepared in accordance with the dimensions stated on the outline drawing / general arrangement drawing.

- Position the pump set on the foundation and check level the baseplate with the help of a spirit level placed on the supporting surfaces for the pump and the motor.
If necessary, remove the pump and motor for this check.
Permissible deviation: 0.2 mm/m.

- If required, use shims (2) to adjust the height. Fit shims between the baseplate / foundation frame and the foundation itself; always insert them to the left and right of the foundation bolts (4) and in close proximity to these bolts.
For a bolt-to-bolt clearance >800 mm, insert additional shims 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.

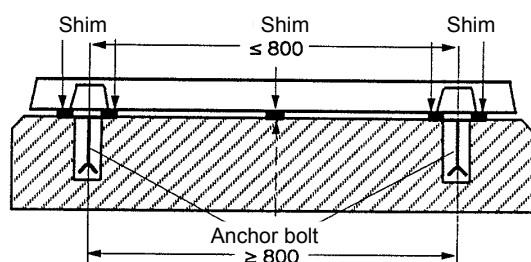


Fig. 5.3-1 Fitting required shims

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

The pump unit consisting of pump, coupling and drive has been mounted on a common baseplate and carefully aligned in the manufacturing works.

The following instructions also apply to units not mounted on a common baseplate.

Caution After connecting the piping and priming the system, it is vital to re-check the alignment at operating temperature.

Caution Incorrect alignment and inadmissible coupling displacement will affect the operating behaviour and may result in damage to the bearings and shaft seals as well as premature coupling wear.

Please note:

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 Figure 5.3-2).

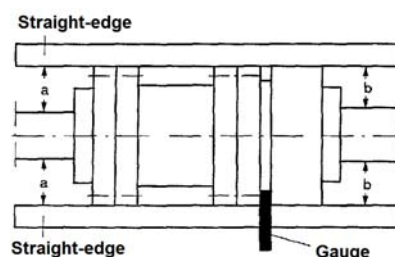


Fig. 5.3-2: Aligning the spacer-type coupling

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

The alignment of the pump and drive shall preferably be checked by means of a dial micrometer. For this purpose remove the spacer sleeve after having marked its installation position by dotting marks (balancing condition).

At the same time check the motor's direction of rotation, with the pump decoupled (see 6.1.4). The direction of rotation must correspond to the direction indicated by the arrow on the pump. This can be verified by switching on the motor for a brief moment and switching it off again immediately.

Fig. 5.3-3 illustrates examples of possible dial micrometer arrangements

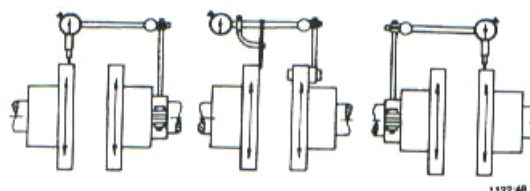


Fig. 5.3-3 Spacer-type coupling alignment with dial micrometer

Admissible run-out of coupling face (axial) max. 0.1 mm.
Admissible radial deviation, measured over the complete circumference, max. 0.2 mm.

5.3.1.1 Aligning the complete unit

Undo pump fastening elements and align pump and motor. (Compensate for any differences in height between pump and motor by means of appropriately sized sheet packs under the feet of the drive.) Re-tighten the bolts on the pump foot and the motor bolts.

For subsequent alignment at operating temperature proceed in the same way.

When using other coupling makes, please refer to any supplementary operating instructions enclosed.

5.3.2 Place of installation



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

Take the necessary precautions to avoid burns!

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

Connection flanges must be parallel to the pump flanges. 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.

Caution

Please check if a strainer / filter should be fitted in the suction line during the commissioning stage, in order to protect both the pump and the shaft seal from damage due to contamination from the pipes.

In order to avoid any marked deterioration of the NPSH available, which would have an adverse effect on the pump, the strainer has to be cleaned whenever required. It is recommended to use a differential pressure gauge to detect any strainer clogging (see 6.1.6).



For installation on a foundation with vibration insulation please take into account when connecting the piping that the flexible elements at the baseplate may only compensate compressive and shearing strains within the admissible limits. Tensile strains cannot be compensated for, therefore the flexible elements shall only be firmly screwed to the foundation after connecting the piping.

5.4.1 Auxiliary connections

The dimensions and locations of the auxiliary connections (cooling, heating, barrier 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!

Modifications are only permitted after consultation with the manufacturer (see 2.7).

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 (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). Seal with PTFE tape, if necessary.

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)

Also check that the following requirements have been fulfilled:

- 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-lubricant 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.

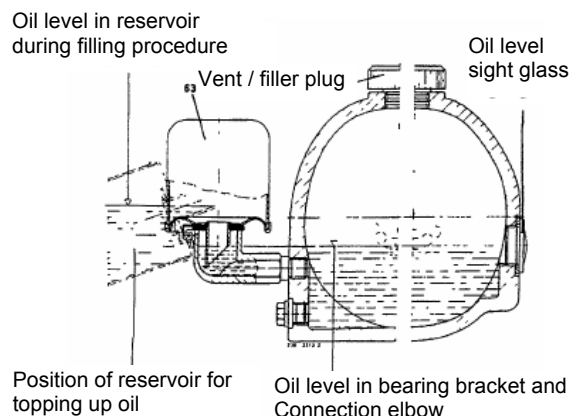


Fig. 6.1-1: Oil fill

Procedure:

Remove the protective cages of the constant-level oilers. 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 operation position. Screw vent plug in again. After a short time check whether the oil level in the reservoirs has dropped. It is important to keep the reservoirs properly filled at all times!

If access to the vent plugs is difficult or impossible, the oil can be filled in through the connection elbows of the constant-level oilers.

Caution The oil level must always be below the level of the "vent" opening arranged at the top edge of the connection elbow. During pump standstill, the oil level can be checked at the oil level sight glass.

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 pressurised double-acting mechanical seals, apply barrier pressure as specified in the installation plan prior to starting up the pump (see 6.1.3). Barrier pressure must also be provided during pump shutdown.

Caution For external liquid supply, the quantities and pressures specified in the data sheet and installation plan shall 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, barrier, 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 5 dH (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 $t_A = \text{máx. } 45^\circ\text{C}$

Caution Dry-running will result in failure of the mechanical seal and must be avoided!

6.1.3.1 Cooling

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

Depending on the medium handled, the mechanical seal design and the mechanical seal materials, the limit may change (example: hot water).

6.1.3.1.1 Cooling of the pump

The stuffing box housings, the bearing brackets and the casing support on the baseplate can be cooled.

$P_{\text{allow}} = 10 \text{ bar}$

$P_{\text{test}} = 15 \text{ bar}$

Cooling liquid quantities:

| | Product Temperature ($^\circ\text{C}$) | Cooling liquid quantities (m^3 / h) | Number of cooling points |
|----------------------|--|---|--------------------------|
| Stuffing box housing | < 250 | 0,3 | 2 |
| Stuffing box housing | < 400 | 0,6 | 2 |
| Bearing bracket | > 200 ¹⁾ | 0,2 | 2 |
| Support on baseplate | > 250 | 0,2 | 2 |

¹⁾ For $n = 3500 \text{ min}^{-1}$

The cooling liquid quantities indicated are based on $\Delta t = \text{max. } 15^\circ\text{C}$.

6.1.3.1.2 Cooling of heat exchanger

For mechanical seals with product circulation the following cooling liquid quantities must be provided for each heat exchanger:

| $n=1/\text{min}$ | m^3 / h |
|------------------|-------------------------|
| 1750 / 1450 | 0,5 |
| 3500 / 2900 | 1,2 |

Fig. 6.1-2 Cooling liquid quantity in m^3/h

6.1.3.2 Heating

The stuffing box housing can be heated by feeding hot water or steam (up to $t = 300\text{ °C}$, $p = 16\text{ bar}$).

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 rotor 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 rotation arrow on the pump. This shall 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 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 shall 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, allow to cool down, then re-tighten the bolts between volute casing / casing cover and between stuffing box housings / volute casing / casing cover. Permissible tightening torques see section 7.5.3.

Caution

Re-check the coupling alignment after the pump has reached operating temperature and re-align, if necessary. (See section 5.3.1).

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.

Caution

This may cause damage to mechanical seals which are not bi-directional!

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 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 bracket temperature as described in section 7.2.1 must be observed.

6.2.1.1 Heating the standby pump

To make sure that the standby pump is operational at all times and to keep it warm, no special precautions need to be taken, providing that

- all cooling points are in operation;
- the permissible nozzle forces and moments are not exceeded.

For extreme conditions, please contact KSB.

6.2.2 Switching frequency

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

| Motor rating (kW) | Max. S (start-ups / h) |
|-------------------|------------------------|
| Up to 100 | 10 |
| Above 100 | 5 |

If the above switching frequencies are exceeded, please contact the motor manufacturers or KSB.

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 must be shortened.

6.2.5 Minimum / maximum flow

For max. flow Q_{\max} please refer to the characteristic curves.

Unless other limits are specified in the characteristic curves, the minimum flow for

50 Hz and $\rho = 1,2 \text{ kg/dm}^3$

60 Hz and $\rho = 1,0 \text{ kg/dm}^3$

is $Q_{\min} = 0,3 \times Q_{\text{opt}}$

Q_{opt} = optimum efficiency

The data refer to water and water-like liquids. However, if the physical properties of the fluids handled are different from water, the calculation formula below must be used to check if an additional heat built-up may lead to a dangerous temperature increase at the pump surface. If necessary, the minimum flow must be increased.

$$T_o = T_f + \Delta\theta$$

$$\Delta\theta = \frac{g * H}{c * \eta} * (1 - \eta)$$

| | | |
|----------------|-------------------------------|----------------------|
| C | Specific heat | [J / kg K] |
| g | Acceleration due to gravity | [m/s ²] |
| H | Pump head | [m] |
| T _f | Temperature of fluid handled | [°C] |
| T _o | Temperature of casing surface | [°C] |
| η | Pump efficiency at duty point | [-] |
| Δθ | Temperature difference | [°C] |

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 for others storage condition contact KSB.

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 authorized, 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 must 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 with the discharge-side shut-off element slightly open for a short period, the permissible pressure and temperature values must not be exceeded. The bearing bracket temperature can be exceeded the ambient temperature till 50°C, never above +90°C. The shut-off elements and the auxiliary feed lines must not be closed during operating.

Any stand-by pumps installed must be started up regularly, e.g. once a week, to keep them operational. Attention shall 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 must be replaced in due time.

Re-align the coupling as described in section 5.3.1.

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... operating hours | All subsequent oil changes every ...operating hours |
|----------------------------|---|---|
| Up to 70°C | 300 | 8500 *) |
| 70°C – 80°C | 300 | 4500 *) |
| 80°C – 90°C | 300 | 2000 *) |

*) at least once a year

Fig. 7.2-1


Procedure

Remove screwed plug below the bearing bracket 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 our HD 20 W / 20 SAE |
| Symbol to DIN 51 502 |  |
| Kinematic viscosity at 40 °C | 46 ± 4 mm ² /s + 175 °C |
| Flash point (to Cleveland) | - 15 °C |
| Solidification point (pour point) | higher than permissible |
| Application temperature ¹⁾ | bearing temperature |

1) For temperatures below -10°C another suitable lubricating oil type must be used. Please contact KSB.

7.2.2.4 Oil quantity

| Bearing bracket | Oil quantity in (liter) |
|-----------------|-------------------------|
| - D01 - | 2 x 0,9 |
| - D02 - | 2 x 1,1 |

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, neutralized, and then for drying purposes anhydrous gas must 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 from both bearing brackets as described in 7.2.2.2.
2. Remove the coupling guard.
3. Dismantle the coupling spacer.
Refer to the additional sheet on couplings, if any!
4. After having unscrewed the socket head cap screw in the coupling hub, pull the coupling half off the pump shaft using the pull-off device and remove key 940.02.
5. Disconnect and remove all auxiliary pipework.
6. Unscrew the hexagon head bolt 901.94 and remove the bearing bracket cover with the bearing isolator.
7. Take out lubricating ring 644.03.
8. Remove circlip 932.32 and pull off shaft sleeve 523.12.
9. Pull the inner race of cylindrical roller bearing 322.07 off the shaft by turning the threaded bush 544.08 (Bearing bracket D01) in anticlockwise direction with the help of a C-wrench. (Heat up the inner bearing race slightly, if necessary!).
10. Remove bearing isolator 420.01.
11. Undo hex. nuts 920.05 and remove bearing bracket 330.12.
12. Engage assembling jigs 59-13 (mech.seal), if any, in the grooves of shaft protecting sleeves 524.2 by

loosening the hex. head bolts for fitting the assembling jigs and re-tightening them.

13. Remove circlip 932.41, if fitted.
14. Loosen the hex. head bolts on locking sleeves (mech.seal), if fitted.
15. Unscrew hex. nuts 920.04 (Bearing bracket D01).

For uncooled shaft seal:

16. Pull the seal cover cover 471.01 with the complete drive-end mechanical seal and shaft protecting sleeve 524.2 off shaft 210.

For cooled shaft seal:

16. Pull stuffing box housing 451.02 with seal cover 471.01, the complete drive end mechanical seal and shaft protecting sleeve 524.2 off shaft 210. Note position of joint ring 411.09.

For cooled and uncooled shaft seal:

17. Loop a rope tightly around the top stay of bearing bracket 330.11.

For uncooled shaft seal:

18. Look the hex. nuts 920.28 and use the forcing screws to pull the complete assembly consisting of bearing bracket 330.11, shaft 210, casing cover 161, the complete pump-end mechanical seal, shaft protecting sleeve 524.2, diffuser plate 173 and impellers 230.01/02 out of volute casing 102.
19. Note position of joint ring 411.57.

For cooled shaft seal:

18. Undo hex. nuts 920.28 and use the forcing screws to pull the complete assembly consisting of bearing bracket 330.11, shaft 210, casing cover 161, stuffing box housing 451.01, seal cover 471.09, the complete pump-end mechanical seal, shaft protecting sleeve 524.2, diffuser plate 173 and impellers 230.01/02 out of volute casing 102.
19. Note position of joint ring 411.57.

For cooled and uncooled shaft seal:

20. Pull off spacer sleeve 525.04.
21. Take the split ring 501.12 and key 940.18 off the shaft 210.
22. Pull off impeller 230.02 with spacer sleeve 525.01.
23. Remove diffuser plate 173 with throttling bush 542.06.

For pumps with fan:

24. Unscrew the screw 901.12 and remove the fan hood 832. Remove the cylindrical pin 562 and remove the fan 831.
25. Unscrew hex. head bolts 901.94 and pull off pump-end bearing cover 360.02.
26. Take out lubricating ring 644.02.

Bearing bracket D01

27. Bend back lockwasher 931.01, unscrew keywayed nut 923.21
28. Undo nuts 920.15 and remove bearing bracket 330.11 (using the forcing screw) with bearing sleeve 529.06, angular contact bearing 320.01 and bearing isolator 420.02.
29. Remove key 940.19 and pull off spacer ring 523.13.

Bearing bracket D02

27. Bend back lockwasher 931.01, unscrew keywayed nut 923.21.
28. Unscrew the screws 901.22 and loose the bearing bracket cover 360.03 with bearing isolator 420.02.

- 29 Undo nuts 920.15 and remove bearing bracket 330.11 using the forcing screw.

Note: Remove the angular contact bearing off shaft 210 using the bearing dismantling kit supplied with the pump. Please observe the dismantling device drawing.

30. Remove circlip 932.42, if fitted.

For uncooled shaft seal:

31. Pull the volute casing 102 with the complete pump-end mechanical seal and shaft protecting sleeve 524.2 off shaft 210.

For cooled shaft seal:

31. Pull stuffing box housing 451.01 with seal cover 471.09, the complete pump-end mechanical seal and shaft protecting sleeve 524.2 off shaft 210.
Note: See the gasket position 411.10.

For cooled and uncooled shaft seal:

32. Pull the complete pump-end mechanical seal and shaft protecting sleeve 524.2 off shaft 210.
Note: See the gasket position 411.10.
33. Pull shaft 210 with impeller 230.01 out of casing cover 161.
34. Remove the split ring 501.11 and key 940.08
35. Remove impeller 230.01 and key 940.01 & 940.08 (Bearing bracket D02).

For uncooled shaft seal:

36. Pull the seal cartridges out of the shaft seal casing 433.
Please observe the installation drawing of the mechanical seal! Proceed in line with this drawing if further dismantling of the mechanical seal is required. Observe supplementary sheet, if any!

For cooled shaft seal:

35. Undo hex. nuts of seal cover and separate seal covers 471.01/02 from the stuffing box housings 451.01/02. Pull the seal cartridges out of stuffing box housings 451.01/02. Please observe the installation drawing of the mechanical seal! Proceed in line with this drawing if further dismantling of the mechanical seal is required. Observe supplementary sheet, if any!

For cooled and uncooled shaft seal:

36. Drive neck bush 456.02 out of volute casing 102 and neck bush 456.01 out of casing cover 161 after having unscrewed grub screws 904.16/26.
37. Also drive throttle bush 542.06 out of diffuser plate 173, having unscrewed socket head cap screws 914.36.
38. Remove the roller cage of cylindrical roller bearing 322.07 from bearing bracket 330.12.
39. Remove the bearing isolator 420.01 / 420.02 out of the bearing brackets.

For cooled bearing brackets (D01 pumps)

40. Cooling covers 165.01/02 and cooling inserts 442.01/02 with O-rings 412.63/64 can be removed and dismantled by unscrewing hex. head bolts 901.46.

7.5 Reassembly

7.5.1 General instructions

The pump shall 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. Always 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 metre.

Caution Do not coat O-rings with graphite or similar products. Use animal fats or silicone-base or PTFE-base lubricants instead. O-rings made of ethylene propylene shall only be coated with silicone grease or soft soap; never use mineral oil or grease!

The locating surfaces of the individual components must 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 section 7.5.3.

Also observe the following additional instructions:

1. Push the pre-assembled rotor unit with the complete shaft 210, impellers 230.01/02, diffuser plate 173, spacer sleeves 525.01/04/05, split locating rings 501.11/12 and throttling bush 542.06 into casing cover 161.
2. Position the casing cover 161 and diffuser plate 173 using parallel pin 562.11, then bolt together with hex. head bolts 901.22.

Mounting the pump-end mechanical seal:

3. For mounting the mechanical seal, please refer to the supplementary sheet, if any, and observe the instructions in section 7.5.4!
4. Place O-ring 412.07 into the groove of shaft protecting sleeve 525.05.
5. Check the sliding fit of the shaft protecting sleeve on the shaft.

6. Make sure the sealing elements and sealing surfaces are clean.
7. Tighten circlip 932.41, if any.
8. Mount locking sleeve 531.01, if any

Mounting the thrust bearing:

9. Position bearing bracket 330.11 with bearing isolator (D01) or bearing isolator / bearing bracket casing cover (D02) over the shaft and bolt to casing cover 161. Check the position of impellers 230.01/02 relative to the diffuser channels.
10. Slip on shaft sleeve 523.13 (D01) or 504.02 (D02).
11. Use only the bearing types and sizes specified in section 4.3.4.3.

Caution

The angular contact ball bearings 320.01 must be installed in "O" arrangement ! (See section 9, General drawing), i.e. the larger diameter of the inner race of each bearing must rest against the bearing sleeve and the keywayed nut, respectively.

Angular contact ball bearings installed in pairs must always be from the same manufacturer.

Heat up angular contact ball bearing 320.01 in an oil bath or by means of an induction heater to approx. 80 °C and push them onto shaft 210 until they will not go any further.

Bearing bracket D01

12. Place key 940.19 into the keyway of the shaft and push bearing sleeve 529.06 (D01) with the angular contact ball bearings onto the shaft and into bearing bracket 330.11

Bearing bracket D02

12. Place the spacer ring 504.02 and the angular contact ball bearings onto the shaft and into bearing bracket 330.11 and put the bearing sleeve 529.06.
13. At first, tighten keywayed nut 923.21 using a C-wrench and without fitting lockwasher 931.01. Let the roller 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 lockwasher 931.01.
14. Insert oil ring 644.02.
15. Slip O-ring 412.81 into the groove of pump-end bearing cover 361.01 with bearing isolator.
16. Mount pump-end bearing cover 361.01, then insert and tighten hex. head bolts 901.94.
17. Install the fan 831 in the shaft. Put the cylindrical pin 562 to lock, then install the fan hood 832 and fix the screw 901.12, if any.
18. Place packing rings 461 around diffuser plate 173, and connect the ends with a shrink sleeve (9.52 x 1.45) by heating (or by switching the packing ends together).
19. Place joint ring 411.57 onto casing cover 161. Then push the complete assembly into volute casing 102 and fasten with hex. nuts 920.28.

Mounting the drive-end mechanical seal:

20. For mounting the mechanical seal, please refer to the supplementary sheet, if any, and observe the instructions in section 7.5.4!
21. Place O-ring 412.34 into the groove of shaft protecting sleeve 524.2.
22. Check the sliding fit of the shaft protecting sleeve on

the shaft.


23. Make sure the sealing elements and sealing surfaces are clean.
24. Tighten circlip 932.41, if any.
25. Position locking sleeves on shaft protecting sleeves 524.01/02, if any, so that there is a gap of 2 mm between the locking sleeves and the mechanical seal covers and tighten the hex. head bolts of the locking sleeves.
26. Mount locking sleeve 531.01, if any.

Mounting the drive-end radial bearing:

27. Carefully position bearing bracket 330.12 with the assembled roller cage of cylindrical roller bearing 322.07 over the shaft and join the bearing components, making sure not to damage the roller bearing and its inner race.

Then bolt the bearing bracket to the volute casing. Position vedador de mancal 420.01 into the bearing bracket 330.12.

28. Slip threaded bush 544.08 onto the shaft and tighten with a clockwise turn of the C-wrench.
29. Heat up the inner race of cylindrical roller bearing 322.07 in an oil bath or by means of an induction heater to approx. 80 °C and push it onto the shaft until it rests against the threaded bush.
30. Slip shaft sleeve 523.12 onto the shaft and mount circlip 932.32.

31.  It is of paramount importance that metal-to-metal contact is established between the casing cover and the volute casing, the stuffing box housing / the shaft seal housing and the volute casing resp. the casing cover, and the bearing brackets and the volute casing / casing cover.

32. Insert oil ring 644.03
33. Slip the "o" ring 412.82 in the bearing bracket cover 380.02
34. Mount bearing cover 360.02, with bearing isolator 420.02, then insert and tighten hex.head bolts 901.94.
35. Place key 940.02 into the keyway of the shaft and pull the pump-side coupling half onto the pump shaft using the pull-on device. Tighten the socket head cap screw in the coupling hub.
36. Mount the coupling spacer.
37. After installation in the volute casing which has remained in the piping, the coupling alignment must be checked as described in section 5.3.1.
38. Mount the coupling guard.
39. Fill in oil as described in section 6.1.1.

7.5.3 Tightening torques

Caution

The studs and nuts connections 902.28 / 920.28 between volute casing 102 and casing

cover 161 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⁾.

Tightening Torques²⁾ in Nm for studs to DIN 938 / 939 with hex. nuts to ISO4032.

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 shall be reduced by 15 to 20%.

| Material | A193 Gr.B7 | | | A193 Gr.B7 | | | A193 Gr.B7 | | | A193 Gr.B7 | | | AISI316 | | | ISO 898-1 Gr.8.8 | | | ISO 898-1 Gr.8.8 | | |
|-----------------------|------------------|--------|------------------|------------------|--------|------------------|--------------------------------|--------|------------------------|-------------------------------|--------|------------------------|--------------------------------|--------|------------------------|--------------------|-----|------------------|--------------------|-----|--------|
| | A194 Gr.2H | | | A194 Gr.2H | | | A194 Gr.2H | | | A194 Gr.2H | | | AISI304 | | | | | | | | |
| Pump Size RPHb | Volute casing | | 102 | Volute casing | | 102 | Volute casing Casing cover | | 102 161 | Volute casing Casing cover | | 102 161 | Seal casing St. box housing | | 441.01/02 451.01/02 | Bearing cover | | 361.01 360.02 | Bearing cover | | 360.03 |
| | Casing cover | | 161 | Cover – Drain | | 160.21 | Seal casing St. box housing | | 441.01/02 451.01/02 | Bearing bracket | | 330.11/12 | Mech.seal cover | | -- | Bearing bracket | | 330.11/12 | Bearing bracket | | 330.11 |
| | Stud Hex. Nut | | 902.28 920.28 | Stud Hex. nut | | 902.20 920.20 | Stud Hex. nut | | 902.04/13 920.04/13 | Stud Hex. nut | | 902.05/15 920.05/15 | Stud Hex. nut | | --- | Hex. Bolt | | 901.94 | Hex. Bolt | | 901.96 |
| | Qty. | Thread | Torque (Nm) | Qty. | Thread | Torque (Nm) | Qty. | Thread | Torque (Nm) | Qty. | Thread | Torque (Nm) | Qty. | Thread | Torque (Nm) | | | Qty. | | | Thread |
| 50-315/2 | 20 | M24 | 804 | 6 | M16 | 239 | 12 12 | M16 | 239 | 4 4 | M16 | 239 | 4 | M16 | 68 | 4 4 | M12 | 85 | 4 | M10 | 50 |
| 80-315/2 | 20 | M24 | 804 | 6 | M16 | 239 | 12 12 | M16 | 239 | 4 4 | M16 | 239 | 4 | M16 | 68 | 4 4 | M12 | 85 | 4 | M10 | 50 |
| 80-360/2 | 24 | M24 | 804 | 6 | M16 | 239 | 12 12 | M16 | 239 | 4 4 | M16 | 239 | 4 | M16 | 68 | 4 4 | M12 | 85 | 4 | M10 | 50 |
| 150-350/2 | 16 | M24 | 804 | 6 | M16 | 239 | -- | -- | -- | 4 4 | M20 | 467 | 4 | M16 | 68 | 4 4 | M12 | 85 | 4 | M10 | 50 |

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 (General instructions)

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 shall 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. (Max. Deviation: 0.02 mm)

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

Clearance gaps between impeller / impeller wear ring and volute casing, casing cover / casing wear ring.

The clearance gaps refer to the diameter!

| Pump Size RPHb | Inner diam. of casing wear ring 502.01/02 | Clearance gap to AN 1501 Gr.2 | Min. clearance gap to API 610 |
|-------------------|---|-------------------------------------|-------------------------------------|
| 50-315/2 | 145 | 0,6 ¹⁾ | 0,432 |
| 80-315/2 | 165 | 0,6 ¹⁾ | 0,457 |
| 80-360/2 | 165 | 0,6 ¹⁾ | 0,457 |
| 150-350/2 | 205 | 0,6 ¹⁾ | 0,508 |

Larger clearance gaps are provided for:
temperature > 200 °C.

In this case, the clearance gap will be increased by + 0,1mm.

7.6 Spare parts stock

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

Type series: RPHb

Pump size:

Works N°:

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

| Part N° | Part description | Number of pumps (including stand-by pumps) | | | | | | |
|--------------|---|--|---|---|---|---|----|-------|
| | | 2 | 3 | 4 | 5 | 6 | 8 | >10 |
| | | Quantity of spare parts | | | | | | |
| 210 | Shaft | 1 | 1 | 2 | 2 | 2 | 3 | 30% |
| 230.01/02 | Impeller (set) | 1 | 1 | 1 | 2 | 2 | 3 | 30% |
| 320.01 | Angular contact ball bearing (set) | 1 | 1 | 2 | 2 | 3 | 4 | 50% |
| 322.07 | Cylindrical roller bearing | 1 | 1 | 2 | 2 | 3 | 4 | 50% |
| 330.11/12 | Bearing bracket (cpl. with shaft and bearings) | - | - | 1 | 1 | 1 | 2 | 4 off |
| 433.01/02 | Mechanical spring-loaded ring | 2 | 3 | 4 | 4 | 4 | 6 | 90% |
| | seal (set) seat ring | 2 | 3 | 4 | 4 | 4 | 6 | 90% |
| | O-rings | 2 | 3 | 6 | 8 | 8 | 10 | 150% |
| | secondary seal at the stationary spring-loaded ring | 2 | 3 | 6 | 8 | 8 | 10 | 150% |
| | spring | 1 | 1 | 1 | 1 | 2 | 2 | 20% |
| 456.01/02 | Neck bush (set) | 1 | 1 | 2 | 2 | 2 | 3 | 30% |
| 502.01/02 | Casing wear ring (set) | 2 | 2 | 2 | 3 | 3 | 4 | 50% |
| 503.01/02 | Impeller wear ring (set) | 2 | 2 | 2 | 3 | 3 | 4 | 50% |
| 524.01/02 | Shaft protecting sleeve (set) | 1 | 1 | 1 | 2 | 2 | 2 | 20% |
| 525.01/04/05 | Spacer sleeve (set) | 1 | 1 | 1 | 2 | 2 | 2 | 20% |
| 542.06 | Throttling bush | 1 | 1 | 2 | 2 | 2 | 3 | 30% |
| --- | Gaskets for volute casing (set) | 4 | 6 | 6 | 8 | 9 | 12 | 150% |
| -- | Other sealing elements (set) | 4 | 6 | 6 | 8 | 9 | 12 | 150% |

7.6.2 Interchangeability of pump components

| Pump Type | Volute casing | Casing cover | Impeller | Diffuser | Wearing ring | Impeller ring | Joint ring |
|---|---|--------------|-------------|----------|--------------|---------------|------------|
| | 102 | 161 | 230.01 / 02 | 173 | 502.01 / 02 | 503.01 / 02 | 411.57 |
| RPHb 50-315/2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| RPHb 80-315/2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| RPHb 80-360/2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| All remaining parts in the above 3 sizes are interchangeable. | | | | | | | |
| RPHb 150-350/2 | Any part is not interchangeable with the above 3 pump size. | | | | | | |

8. Trouble-shooting

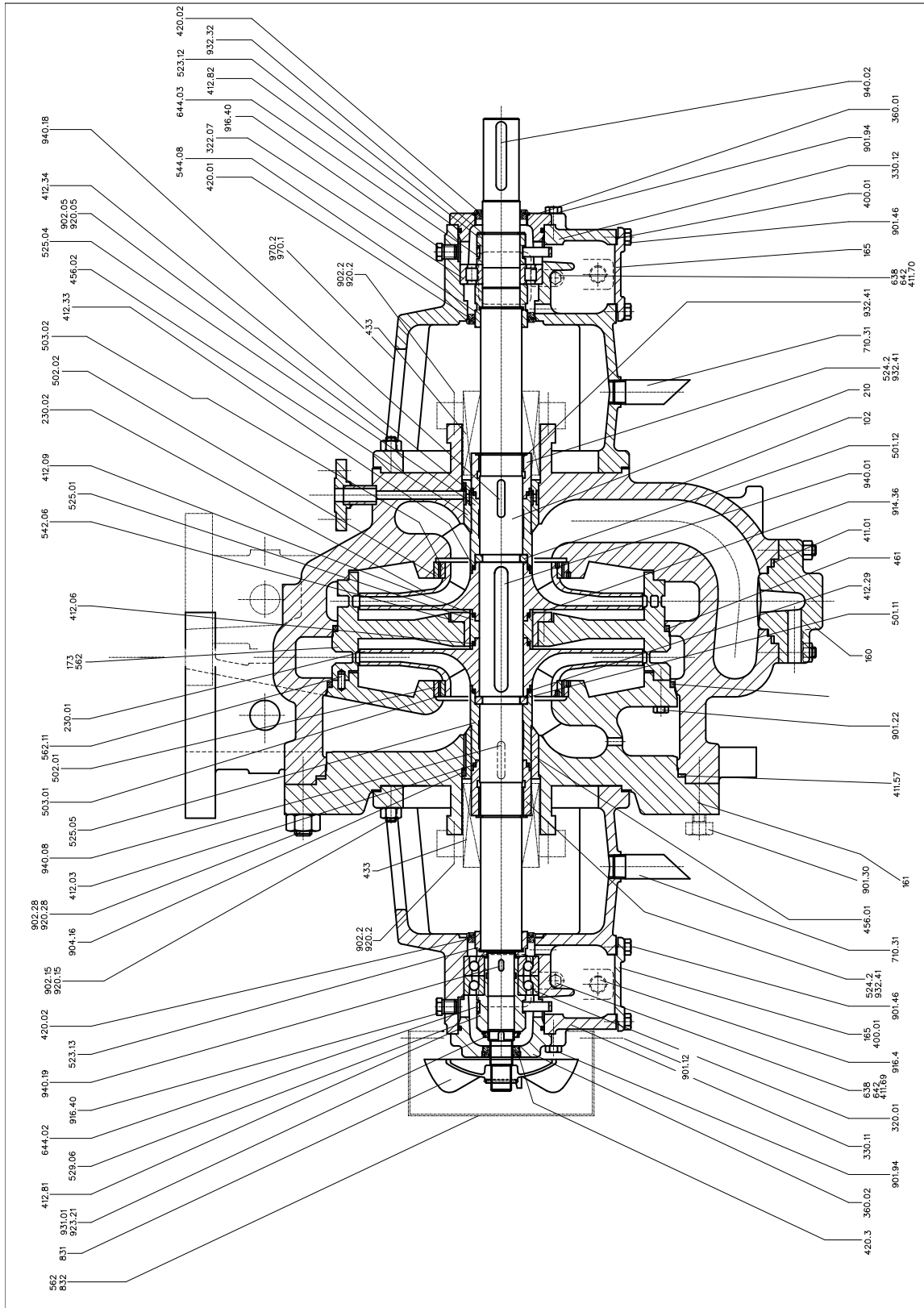
| Pump delivers insufficient flow rate | Motor is overload | Excessive pump discharge pressure | Increase in bearing temperature | Leakage at the pump | Excessive leakage at the shaft seal | Vibrations during pump operation | Excessive rise of temperature inside the pump | Cause | Remedy ¹⁾ |
|--------------------------------------|-------------------|-----------------------------------|---------------------------------|---------------------|-------------------------------------|----------------------------------|---|--|--|
| • | | | | | | | | Pump delivers against an excessive 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. |
| • | | | | | | | | 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 sleeves. Fit new shaft seals/ 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 assembly drawing

9.1 RPHb: 50-315/2

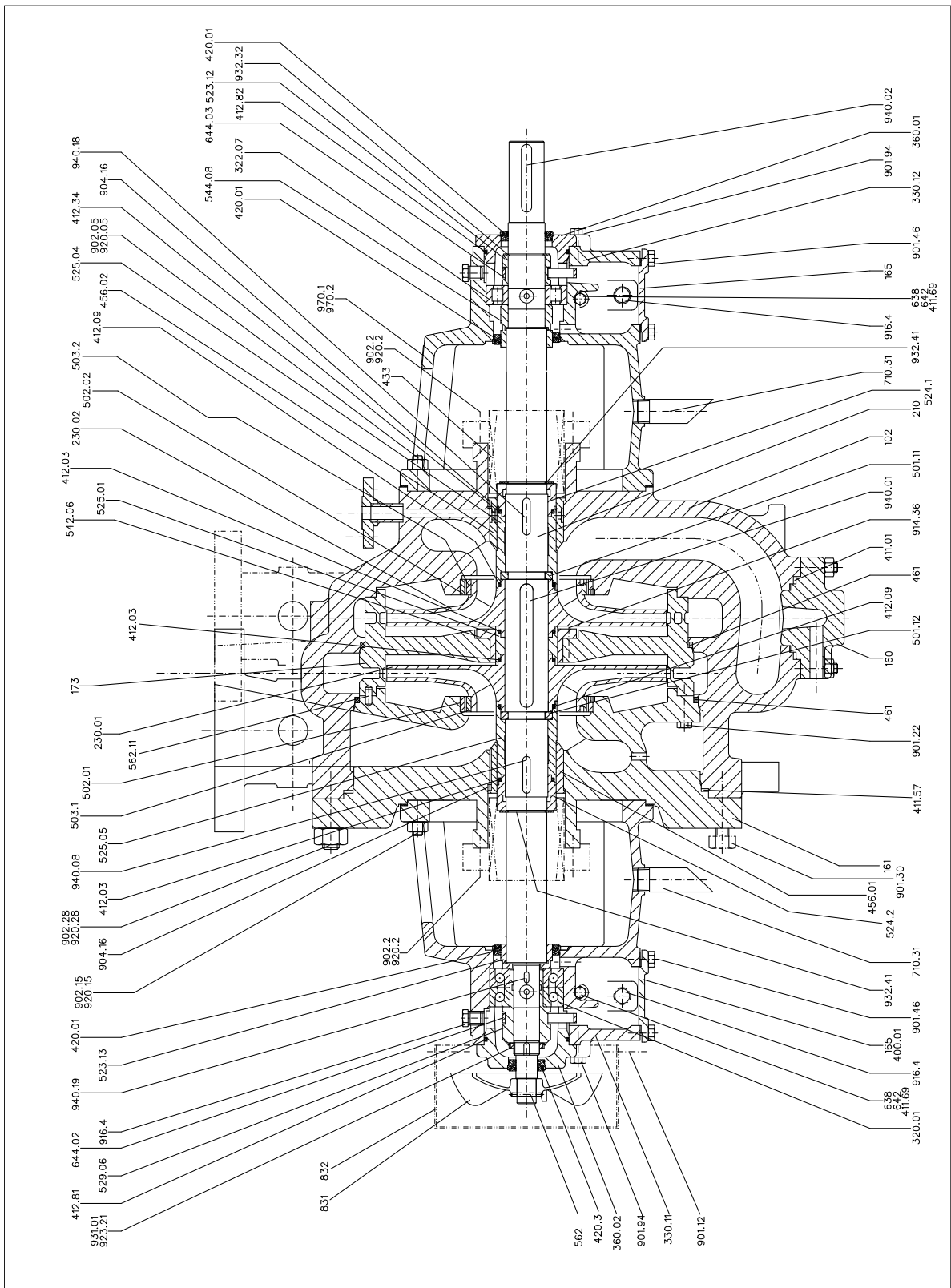


List of components

| Part n° | Description |
|-----------|--------------------------------|
| 102 | Volute casing |
| 160 | Cover |
| 161 | Casing cover |
| 165 | Cooling cover |
| 173 | Diffuser plate |
| 210 | Shaft |
| 230.01 | Impeller 1 st stage |
| 230.02 | Impeller 2 nd stage |
| 320.01 | Angular contact ball bearing |
| 322.07 | Radial roller bearing |
| 330.11 | Bearing bracket |
| 330.12 | Bearing bracket |
| 360.01 | Bearing cover |
| 360.02 | Bearing cover |
| 400.01 | Flat gasket |
| 411.01 | Gasket |
| 411.57 | Gasket |
| 411.69 | Gasket |
| 411.7 | Gasket |
| 412.03 | O-ring |
| 412.06 | O-ring |
| 412.09 | O-ring |
| 412.29 | O-ring |
| 412.33 | O-ring |
| 412.34 | O-ring |
| 412.81 | O-ring |
| 412.82 | O-ring |
| 420.01 | Shaft seal ring |
| 420.02 | Shaft seal ring |
| 420.3 | Shaft Seal ring |
| 433 | Mechanical seal |
| 456.01 | Neck bush |
| 456.02 | Neck bush |
| 461.15/16 | Gland packing |
| 501.11 | Split ring |
| 501.12 | Split ring |
| 502.01 | Wearing ring |
| 502.02 | Wearing ring |
| 503.01 | Impeller wear ring |
| 503.02 | Impeller wear ring |
| 523.12 | Shaft sleeve |
| 523.13 | Shaft sleeve |

| Part n° | Description |
|-----------|-------------------------|
| 524.2 | Shaft protecting sleeve |
| 525.01 | Spacer sleeve |
| 525.04 | Spacer sleeve |
| 525.05 | Spacer sleeve |
| 529.06 | Bearing sleeve |
| 542.06 | Throttling bush |
| 544.08 | Threaded bush |
| 562 | Cylindrical pin |
| 562.11 | Cylindrical pin |
| 638 | Constant level oiler |
| 642 | Oil level sight glass |
| 644.02 | Lubrication ring |
| 644.03 | Lubrication ring |
| 710.31 | Drain pipe |
| 831 | Fan impeller |
| 832 | Fan hood |
| 901.3 | Hexagon head bolt |
| 901.12 | Hexagon head bolt |
| 901.22 | Hexagon head bolt |
| 901.46 | Hexagon head bolt |
| 901.94 | Hexagon head bolt |
| 902.05 | Stud |
| 902.15 | Sud |
| 902.28 | Stud |
| 904.16 | Threaded pin |
| 914.36 | Socket head cap screw |
| 916.4 | Plug |
| 920.05 | Nut |
| 920.2 | Nut |
| 920.15 | Nut |
| 920.28 | Nut |
| 923.21 | Bearing nut |
| 931.01 | Lockwasher |
| 932.32 | Circlip |
| 932.41/42 | Ciclip |
| 940.01 | Key |
| 940.02 | Key |
| 940.08 | Key |
| 940.18 | Key |
| 940.19 | Key |
| 970.1 | Plate |
| 970.2 | Plate |

RPHb: 80-315/2



List of components

| Part n° | Description |
|-----------|--------------------------------|
| 102 | Volute casing |
| 160 | Cover |
| 161 | Casing cover |
| 165 | Cooling cover |
| 173 | Diffuser plate |
| 210 | Shaft |
| 230.01 | Impeller 1 st stage |
| 230.02 | Impeller 2 nd stage |
| 320.01 | Angular contact ball bearing |
| 322.07 | Radial roller bearing |
| 330.11 | Bearing bracket |
| 330.12 | Bearing bracket |
| 360.01 | Bearing cover |
| 360.02 | Bearing cover |
| 400.01 | Flat gasket |
| 411.01 | Gasket |
| 411.57 | Gasket |
| 411.69 | Gasket |
| 412.34 | O-ring |
| 412.09 | O-ring |
| 412.81 | O-ring |
| 420.01 | Shaft seal ring |
| 420.02 | Shaft seal ring |
| 420.3 | Shaft seal ring |
| 433 | Mechanical seal |
| 456.01 | Neck bush |
| 456.02 | Neck bush |
| 461.15/16 | Gland packing |
| 501.11 | Split ring |
| 501.12 | Split ring |
| 502.01 | Wearing ring |
| 502.02 | Wearing ring |
| 503.1 | Impeller wear ring |
| 503.2 | Impeller wear ring |
| 523.12 | Shaft sleeve |
| 523.13 | Shaft sleeve |
| 524.2 | Shaft protecting sleeve |
| 525.01 | Spacer sleeve |

| Part n° | Description |
|---------|-----------------------|
| 525.05 | Spacer sleeve |
| 529.06 | Bearing sleeve |
| 542.06 | Throttling bush |
| 544.08 | Threaded bush |
| 562 | Cylindrical pin |
| 562.11 | Cylindrical pin |
| 638 | Constant level oiler |
| 642 | Oil level sight glass |
| 644.02 | Lubrication ring |
| 644.03 | Lubrication ring |
| 710.31 | Drain Pipe |
| 831 | Fan impeller |
| 832 | Fan hood |
| 901.3 | Hexagon head bolt |
| 901.12 | Hexagon head bolt |
| 901.22 | Hexagon head bolt |
| 901.46 | Hexagon head bolt |
| 901.94 | Hexagon head bolt |
| 902.2 | Stud |
| 902.05 | Stud |
| 902.15 | Stud |
| 902.28 | Stud |
| 904.16 | Threaded pin |
| 914.36 | Socket head cap screw |
| 916.4 | Plug |
| 920.05 | Nut |
| 920.15 | Nut |
| 920.28 | Nut |
| 923.21 | Bearing nut |
| 931.01 | Lockwasher |
| 932.32 | Circlip |
| 932.41 | Circlip |
| 940.01 | Key |
| 940.02 | Key |
| 940.08 | Key |
| 940.18 | Key |
| 940.19 | Key |
| 970.1 | Plate |
| 970.2 | Centering screw |

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List of components

| Part n° | Description |
|-----------|--------------------------------|
| 102 | Volute casing |
| 160 | Cover |
| 161 | Casing cover |
| 165 | Cooling cover |
| 173 | Diffuser plate |
| 210 | Shaft |
| 230.01 | Impeller 1 st stage |
| 230.02 | Impeller 2 nd stage |
| 320.01 | Angular contact ball bearing |
| 322.07 | Radial roller bearing |
| 330.11 | Bearing bracket |
| 330.12 | Bearing bracket |
| 360.01 | Bearing cover |
| 360.02 | Bearing cover |
| 400.01 | Flat gasket |
| 411.01 | Gasket |
| 411.57 | Gasket |
| 411.69 | Gasket |
| 411.7 | Gasket |
| 412.81 | O-ring |
| 412.06 | O-ring |
| 412.09 | O-ring |
| 412.29 | O-ring |
| 412.33 | O-ring |
| 412.34 | O-ring |
| 412.81 | O-ring |
| 412.82 | O-ring |
| 420.01 | Shaft seal ring |
| 420.02 | Shaft seal ring |
| 420.3 | Shaft seal ring |
| 433 | Mechanical seal |
| 456.01 | Neck bush |
| 456.02 | Neck bush |
| 461.15/16 | Gland packing |
| 501.11 | Split ring |
| 501.12 | Split ring |
| 502.01 | Casing wear ring |
| 502.02 | Casing wear ring |
| 503.01 | Impeller wear ring |
| 503.02 | Impeller wear ring |
| 523.12 | Shaft sleeve |
| 523.13 | Shaft sleeve |

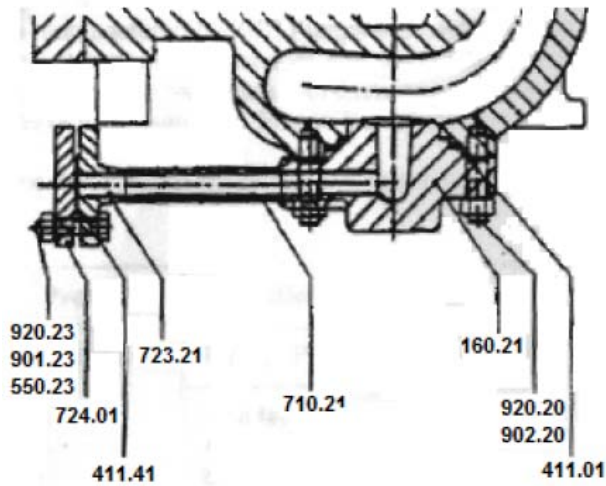
| Part n° | Description |
|---------|-------------------------|
| 524.2 | Shaft protecting sleeve |
| 525.01 | Spacer sleeve |
| 525.04 | Spacer sleeve |
| 525.05 | Spacer sleeve |
| 529.06 | Bearing sleeve |
| 542.06 | Throttling bush |
| 544.08 | Threaded bush |
| 562 | Cylindrical pin |
| 562.11 | Cylindrical pin |
| 638 | Constant level oiler |
| 642 | Oil level sight glass |
| 644.02 | Lubrication ring |
| 644.03 | Lubrication ring |
| 710.31 | Drain pipe |
| 831 | Fan impeller |
| 832 | Fan hood |
| 901.3 | Hexagon head bolt |
| 901.12 | Hexagon head bolt |
| 901.22 | Hexagon head bolt |
| 901.46 | Hexagon head bolt |
| 901.94 | Hexagon head bolt |
| 902.2 | Stud |
| 902.05 | Stud |
| 902.28 | Stud |
| 904.16 | Threaded pin |
| 914.36 | Socket head cap screw |
| 916.4 | Plug |
| 920.2 | Nut |
| 920.05 | Nut |
| 920.15 | Nut |
| 920.28 | Nut |
| 923.21 | Bearing nut |
| 931.01 | Lockwasher |
| 932.32 | Circlip |
| 932.41 | Circlip |
| 940.01 | Key |
| 940.02 | Key |
| 940.08 | Key |
| 940.18 | Key |
| 940.19 | Key |
| 970.1 | Plate |
| 970.2 | Plate |

List of components

| Part n° | Description |
|-----------|--------------------------------|
| 102 | Volute casing |
| 160 | Cover |
| 161 | Casing cover |
| 173 | Diffuser plate |
| 210 | Shaft |
| 230.01 | Impeller 1 st stage |
| 230.02 | Impeller 2 nd stage |
| 320.01 | Antifriction bearing |
| 322.07 | Radial roller bearing |
| 330.11 | Bearing bracket |
| 330.12 | Bearing bracket |
| 360.01 | Bearing cover |
| 360.02 | Bearing cover |
| 360.03 | Bearing cover |
| 400.01 | Flat gasket |
| 400.02 | Flat gasket |
| 411.01 | Gasket |
| 411.57 | Gasket |
| 412.01 | O-ring |
| 412.02 | O-ring |
| 412.03 | O-ring |
| 420.01 | Shaft seal ring |
| 420.02 | Shaft seal ring |
| 420.81 | Shaft seal ring |
| 433 | Mechanical seal |
| 456.01 | Neck bush |
| 456.02 | Neck bush |
| 461.15/16 | Gland packing |
| 501.11 | Multiple ring |
| 501.12 | Multiple ring |
| 502.01 | Casing wear ring |
| 502.02 | Casing wear ring |
| 503.01 | Impeller wear ring |
| 503.02 | Impeller wear ring |
| 504 | Spacer ring |
| 504.01 | Spacer ring |
| 504.02 | Spacer ring |
| 523.12 | Shaft sleeve |
| 523.13 | Shaft sleeve |
| 525.01 | Spacer sleeve |

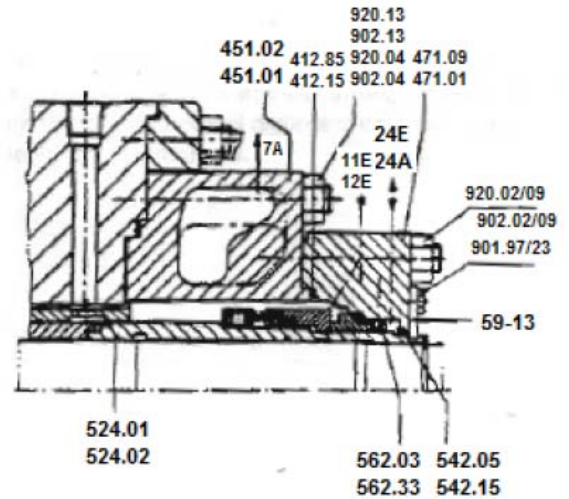
| Part n° | Description |
|---------|-----------------------|
| 525.05 | Spacer sleeve |
| 529.06 | Bearing sleeve |
| 542.06 | Throttling bush |
| 562 | Cylindrical pin |
| 562.11 | Cylindrical pin |
| 638 | Constant level oiler |
| 642 | Oil level sight glass |
| 644.02 | Lubrication ring |
| 644.03 | Lubrication ring |
| 672 | Venting |
| 710.31 | Pipe |
| 831 | Fan impeller |
| 832 | Fan hood |
| 901.3 | Hexagon |
| 901.12 | Hexagon head bolt |
| 901.22 | Hexagon head bolt |
| 901.94 | Hexagon head bolt |
| 902.04 | Stud |
| 902.05 | Stud |
| 904.16 | Threaded pin |
| 904.16 | Threaded pin |
| 904.26 | Threaded pin |
| 920.04 | Nut |
| 920.05 | Nut |
| 920.15 | Nut |
| 920.28 | Nut |
| 923.21 | Bearing nut |
| 931.01 | Lockwasher |
| 932.32 | Circlip |
| 932.41 | Circlip |
| 940.01 | Key |
| 940.02 | Key |
| 940.03 | Key |
| 940.08 | Key |
| 940.18 | Key |
| 940.19 | Key |
| 970.01 | Plate |
| 970.02 | Centering screw |

9.3 Design variants



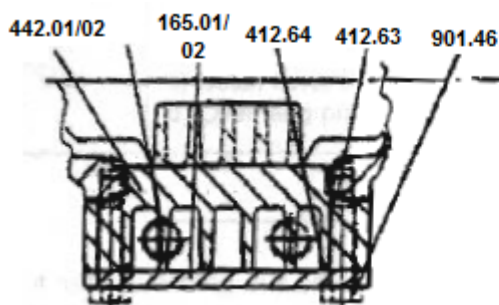
Drain line

| | |
|-----------|---------------|
| 160.21 | Cover |
| 902.20 | Stud |
| 920.20/23 | Hex.nut |
| 411.01/41 | Joint ring |
| 710.21 | Pipe |
| 723.01 | Flange |
| 724.01 | Blind flange |
| 901.23 | Hex.head bolt |
| 550.23 | Washer |



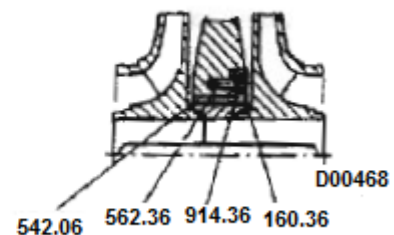
Cooled shaft seal (D01 pumps)

| | |
|-----------|----------------------|
| 524.01/02 | Shaft sleeve |
| 562.03/33 | Parallel pin |
| 542.05/15 | Throttle bush |
| 451.01/02 | Stuffing box housing |
| 412.85/15 | O-rings |
| 902.02/09 | Stud |
| 920.02/09 | Hex. nut |
| 920.04/13 | Hex. nut |
| 471.01/09 | Seal cover |
| 901.97/23 | Hex. head bolt |
| 59-13 | Assembling jig |



Cooled bearing bracket (D01 pumps)

| | |
|-----------|----------------|
| 442.01/02 | Cooling insert |
| 165.01/02 | Cooling cover |
| 412.63/64 | O-ring |
| 901.46 | Hex-head bolts |



Alternatively with floating labyrinth

| | |
|--------|----------------------------|
| 542.06 | Throttling bush |
| 562.36 | Parallel pin |
| 914.36 | Hex. socket head cap screw |
| 160.36 | Cover |

10 ADDENDUM 1

SPECIAL INSTRUCTION FOR PUMPS OIL MIST LUBRICATED

In case of oil mist lubrication, constant level oilers and sight glasses are omitted as per API 610.

Inlet and outlet connections are provide upon request.

A pre-operation of 3 minutes before each start-up of the pump is recommended to the oil mist generator in order to provide some lubricant inside the pump bearing housings.

Recommended oil mist pressure to be 0,03 to 0,05 bar at the point of introduction to the bearing housing.

KSB should be informed previously by the customer in respect of type of oil to be used and give its approval.

For these cases customer/end user should use the cross sectional drawing and parts list include in data-books.

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