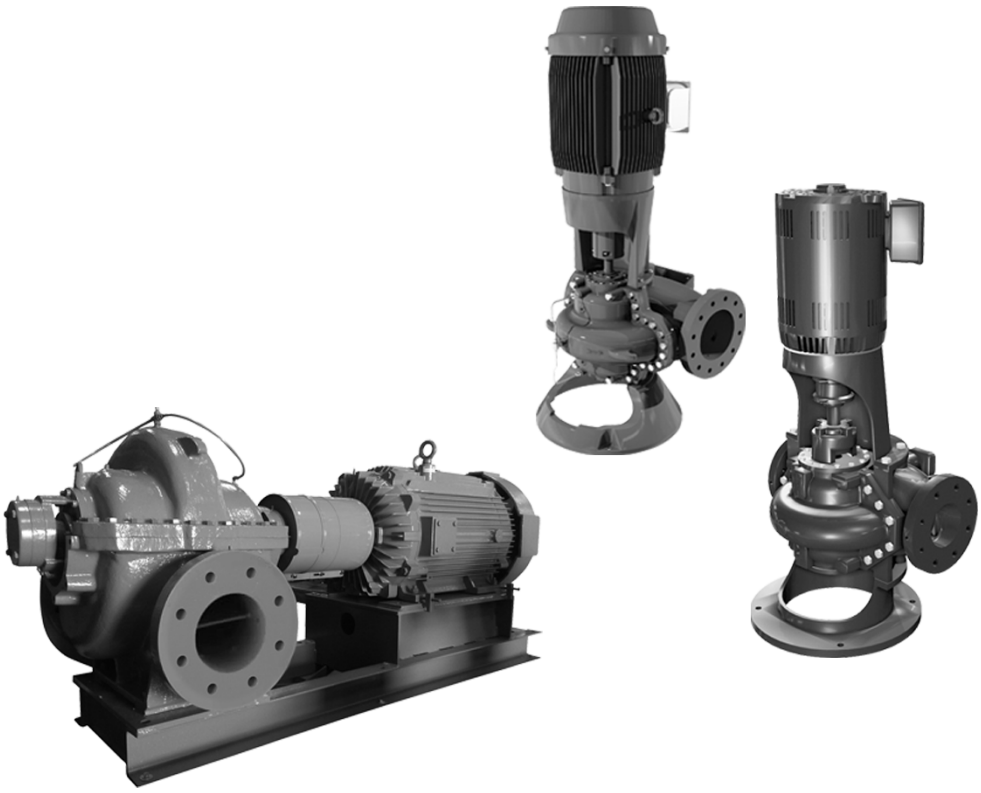
KP, KPV, KPVS

Split-case centrifugal pumps

Installation and operating instructions



KP, KPV, KPVS

English (US)
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Original installation and operating instructions

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1. General information

Read this document before you install the product. Installation and operation must comply with local regulations and accepted codes of good practice.

1.1 Limited warranty

New equipment manufactured by seller or service supplied by seller is warranted to be free from defects in material and workmanship under normal use and service for a minimum of twelve (12) months from date of installation, eighteen (18) months from date of shipment, unless otherwise stated in product warranty guide (available upon request). In the case of spare or replacement parts manufactured by seller, the warranty period shall be for a period of twelve months from shipment. Seller's obligation under this warranty is limited to repairing or replacing, at its option, any part found to its satisfaction to be so defective, provided that such part is, upon request, returned to seller's factory from which it was shipped, transportation prepaid. Parts replaced under warranty shall be warranted for twelve months from the date of the repair, not to exceed the original warranty period. This warranty does not cover parts damaged by decomposition from chemical action or wear caused by abrasive materials, nor does it cover damage resulting from misuse, accident, neglect, or from improper operation, maintenance, installation, modification or adjustment. This warranty does not cover parts repaired outside seller's factory without prior written approval. Seller makes no warranty as to starting equipment, electrical apparatus or other material not of its manufacture. If purchaser or others repair, replace, or adjust equipment or parts without seller's prior written approval, seller is relieved of any further obligation to purchaser under this paragraph with respect to such equipment or parts, unless such repair, replacement, or adjustment was made after seller failed to satisfy within a reasonable time seller's obligations under this paragraph. Seller's liability for breach of these warranties (or for breach of any other warranties found by a court of competent jurisdiction to have been given by seller) shall be limited to: (a) accepting return of such equipment exw plant of manufacture, and (b) refunding any amount paid thereon by purchaser (less depreciation at the rate of 15% per year if purchaser has used equipment for more than thirty [30] days), and canceling any balance still owing on the equipment, or (c) in the case of service, at seller's option, redoing the service, or refunding the purchase order amount of the service or portion thereof upon which such liability is based. These warranties are expressly in lieu of any other warranties, express or implied, and seller specifically disclaims any implied warranty of merchantability or fitness for a particular purpose, and in lieu of any other obligation or liability on the part of the seller whether a claim is based upon negligence, breach of warranty, or any other theory or cause of action. In no event shall seller be liable for any consequential, incidental, indirect, special or punitive damages of any kind. For purposes of this paragraph, the equipment warranted shall not include equipment, parts, and work not manufactured or performed by seller. With respect to such equipment, parts, or work, seller's only obligation shall be to assign to purchaser the warranties provided to seller by the manufacturer or supplier providing such equipment, parts or work. No equipment furnished by seller shall be deemed to be defective by reason of normal wear and tear, failure to resist erosive or corrosive action of any fluid or gas, purchaser's failure to properly store, install, operate, or maintain the equipment in accordance with good industry practices or specific recommendations of seller, including, but not limited to seller's installation and operation manuals, or purchaser's failure to provide complete and accurate information to seller concerning the operational application of the equipment.

1.2 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

DANGER
Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING
Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION
Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:

SIGNAL WORD
Description of the hazard
Consequence of ignoring the warning
- Action to avoid the hazard.

1.3 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

FM Observe these instructions for explosion-proof products.

A blue or gray circle with a white graphical symbol indicates that an action must be taken.

A red or gray circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Tips and advice that make the work easier.

1.4 Target group

These installation and operating instructions are intended for professional installers and for the operators of the product.

We recommend that installation is carried out by skilled persons with technical qualifications required by the specific legislation in force.

2. Receiving the product

WARNING
Damage to personnel or product
Death or serious personal injury
- Allow only qualified personnel to handle the product during receiving, inspecting, and unpacking.

2.1 Unpacking the product

WARNING
Overhead load
Death or serious personal injury
- Do not lift the product by the lifting lugs or eye bolts on the motor.
- Unload and handle the product with a sling.
- All complete horizontal KP pump units must be lifted by fork truck from beneath the pump's steel base.

WARNING
Crushing hazard
Death or serious personal injury
- Always lift the pump with lifting equipment.
- Use the correct lifting points.

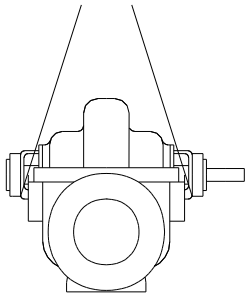
2.1.1 Lifting and handling

Do not use lifting lugs on the pump or eye bolts on the motor to lift the entire pump assembly.

Lifting the equipment is the responsibility of the customer. The following instructions are suggestions only.

2.1.1.1 Lifting horizontal KP pumps without motor

1. Before unloading the product, move the shipping container to an open area equipped with overhead lifting equipment.
2. Install a lifting strap on each side of the bearing housing. See the figure below.

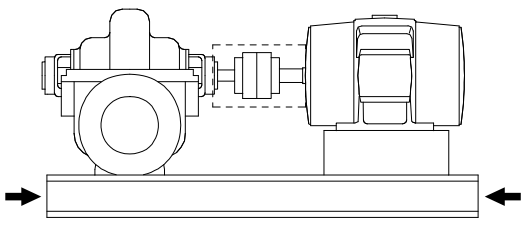


TM040380

KP bare shaft pumps, correct lifting points

2.1.1.2 Lifting horizontal KP pumps complete with motor

1. Before unloading the product, move the shipping container to an open area equipped with overhead lifting equipment.
2. Lift the complete horizontal KP pump by fork truck from beneath the steel base of the pump.



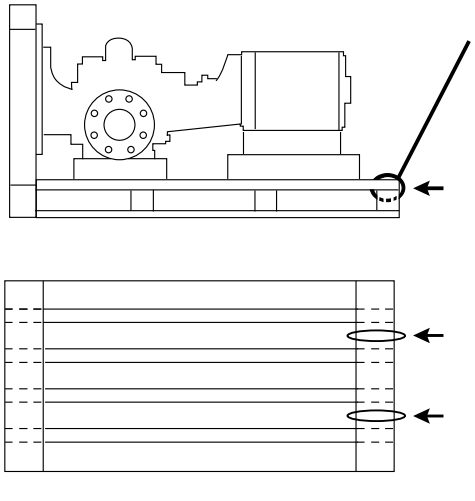
TM068436

Complete horizontal KP pump, correct lifting points

2.1.1.3 Lifting KPV, KPVS (vertical) pumps

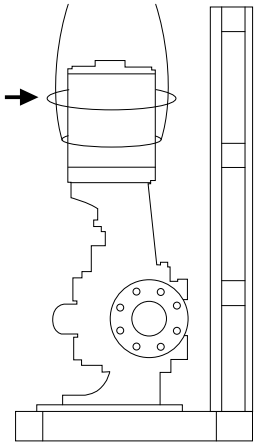
Before unloading the product, move the shipping container to an open area equipped with an overhead lifting mechanism.

1. Install a lifting strap on each of the 4-by-4-inch floor boards of the pallet. Attach the straps securely at the corners of the pallet near the top of the pump motor. See the figure below.



KPV, KPVS pumps, correct lifting points for pallet

2. Attach the other end of the straps to a lifting hook.
3. Rotate the pump assembly to the vertical position.
4. Remove excess packaging for easier access to the pump assembly.
5. Position two lifting straps around the motor, below the junction box and 180° apart. See figure below.



KPV, KPVS pumps, correct lifting points

6. Carefully tighten the straps.
7. Attach the free ends of the lifting straps to a lifting hook.
8. Tie a strap around the upper portion of the motor to hold the lifting straps tight against the motor. Ensure the straps stay tight against the motor while moving the pump assembly.
9. Utilize appropriately rated lifting equipment to move the pump assembly to the installation location.

2.2 Inspecting the product

1. Make sure that the product received is in accordance with the order.
2. Make sure that the voltage and frequency of the product match the voltage and frequency of the installation site. See section *6.3.1 Nameplate* for data.
3. Check the product for defects and damage immediately upon arrival. Any accessories ordered will be packed in a separate container and shipped with the product.
4. If any equipment is damaged in transit, promptly report this to the carrier's agent. Make complete notations on the freight bill.

2.3 Temporary storage after delivery

If the product is not to be installed and operated immediately after receiving it, store it in a clean, dry place at a moderate ambient temperature. Protect the pump from moisture, dust, dirt and foreign bodies. Prior to and during storage, we recommend the following precautions:

1. Make sure that the bearings are filled with the recommended grease to prevent moisture from entering around the shaft. See section *7.1.2 Lubrication of the pump bearings*.
2. Make sure that the inlet and outlet ports of the pump and all other openings are covered with cardboard, wood or masking tape to prevent foreign objects from entering the pump.
3. Cover the product with a tarpaulin or other suitable covering if it is to be stored where there is no protective covering.
4. Rotate the shaft 2 turns every 2 weeks to coat the bearings, stuffing box (packing), and shaft seal faces with lubricant to prevent oxidation and corrosion.
5. This equipment contains vegetable fiber gaskets that can dry out during long storage periods. To avoid leaks, fill the pump with water and let it stand for 24 hours prior to startup or pressure testing. Typically, this will allow the dry gaskets to wick moisture back into themselves, sealing the pump.
6. Split case pumps must be pressurized only with the medium they are intended to pump.

Do not perform any pressurized air test.

3. Installation of the product

All installations must be performed by personnel experienced in the placement, connection, and alignment of pumping equipment. The following instructions are general in nature, and may not deal with the specifics of your installation. Read these instructions thoroughly before installing and operating your KP, KPV, or KPVS pump.

3.1 Selecting the optimal location

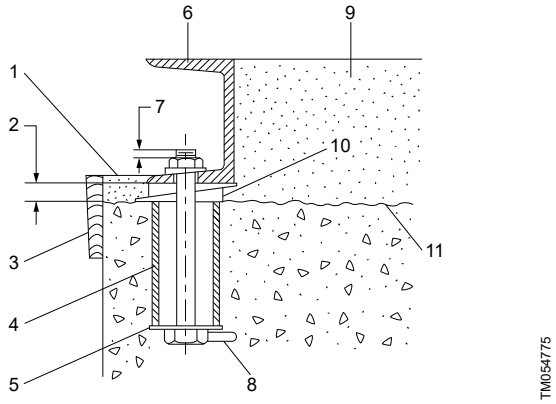
1. Position the pump as close as possible to the liquid supply. Use the shortest and most direct inlet pipe practical. Refer to section *3.4.2 Installing the inlet pipe*.
2. Locate the pump below system level wherever possible. This facilitates priming, assures a steady liquid flow, and provides a positive inlet pressure.
3. The Net Positive Suction Head (NPSH) available must always be equal to or exceed the NPSH required specified on the pump performance curve. Make sure that sufficient NPSH is provided at the inlet.
4. Always allow sufficient space for maintenance and inspection. Provide a clearance of 24 inches (610 mm) with ample head room for use of overhead lifting equipment strong enough to lift the product.
5. Do not expose the product to sub-zero temperatures to prevent the pumped liquid from freezing. If there is frost during shutdown periods, see the shutdown information included in the section *7.8 Taking the product out of operation*.

3.2 Preparing the pump foundation

Install the pump on a firm, raised concrete foundation of sufficient size to dampen any vibration and prevent any deflection or shaft misalignment. The foundation may float on springs or be a raised part of the floor.

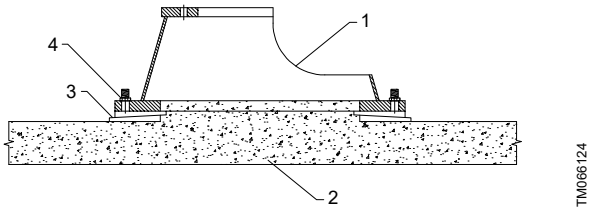
Proceed as follows:

1. Pour the foundation without interruption to 0.75 - 1.5 inches (20-35 mm) below the final pump level.
2. Scour and groove the top surface of the foundation before the concrete sets to provide a suitable bonding surface for the grout.
3. Place anchor bolts in the pipe sleeves for positioning allowance. See the figures below.
4. Allow enough bolt length for the grout, base, flange, nuts, and washers.
5. Allow the foundation to cure several days before proceeding to install the pump.



KP anchor bolt installation

1	Finished grouting	7	0.25 in.
2	0.75 to 1.25 in. (20 to 32 mm) allowance for grout	8	Lug
3	Formwork	9	Grout
4	Pipe sleeve	10	Wedges or shims left in place
5	Washer	11	Top of foundation
6	Base plate		



KPV, KPVS anchor bolt installation

1	KPV, KPVS stand	3	Wedges or shims (as required)
2	Grouted pad for anchoring/ housekeeping	4	Anchor bolts for supporting the base

3.3 Securing the base plate

When the raised concrete foundation has been poured and allowed to set, proceed as follows:

1. Lower the base plate over the anchor bolts and rest it on loose adjustment wedges or shims placed near each anchor bolt at intervals not exceeding 24 inches (610 mm) along each side.
2. Place the shims or wedges so that they raise the bottom of the base plate 0.75 - 1.25 inches (20-32 mm) above the pad, allowing clearance for grouting.
3. Level the pump shaft, flanges, and the base plate using a spirit level, adjusting the wedges or shims, as required.

   Place a spirit level on top of the pump to check that it is level.

4. Make sure that the pipes can be aligned to the pump flanges without placing any strain on either flange.
5. After the pump alignment is established, put nuts on the anchor bolts and tighten them just enough to keep the base plate from moving.
6. Construct a formwork around the concrete foundation and pour grout inside and around the base plate. See figures 'KP anchor bolt installation' and 'KPV, KPVS anchor bolt installation' within section *3.2 Preparing the pump foundation*. The grout compensates for uneven foundation, distributes the weight of the pump, and prevents shifting.

   Use an approved, non-shrinking grout.

7. Allow at least 24 hours for the grout to set before proceeding with the pipe connections.
8. After the grout thoroughly hardens, check the anchor bolts and tighten them if necessary. Re-check the pump alignment after tightening the anchor bolts.

3.4 Mechanical installation

3.4.1 Piping

Do not let the pump support the pipes. Use pipe hangers or other supports at proper intervals to provide pipe support near the pump.

Make sure that both the inlet and outlet pipes are independently supported and properly aligned so that no strain is transmitted to the pump when the flange bolts are tightened. Use of expansion joints or vibration pads does not preclude the need to properly support the pipes. Make sure that the pipes are as straight as possible, so as to avoid unnecessary bends and fittings.

KP, KPV, KPVS pumps have 250-pound flanges which are drilled according to the service of the pump. Non-standard hardware may be required.

Do not apply force to pipes when making connections.

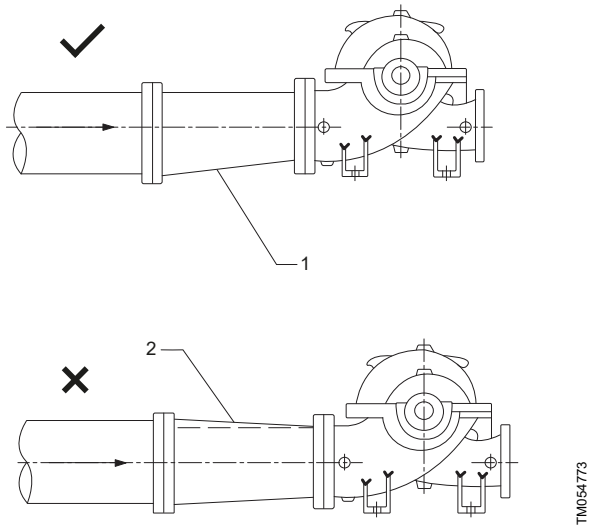
3.4.2 Installing the inlet pipe

Select and install the inlet pipe in a manner that minimizes pressure loss and permits sufficient liquid flow into the pump during starting and operation.

Many NPSH issues can be traced to improper selection and installation of the inlet pipe.

Observe the following precautions when installing the inlet pipe:

1. Run the inlet pipe as straight as possible to avoid unnecessary bends and fittings. Ideally, make sure that the length is at least five times the pipe diameter. A short inlet pipe can be the same diameter as the inlet port. A long pipe must be one or two sizes larger than the inlet port, depending on the length, and with a reducer added between the pipe and the inlet port.
2. Use an eccentric reducer, with the tapered side down. See the figure below.

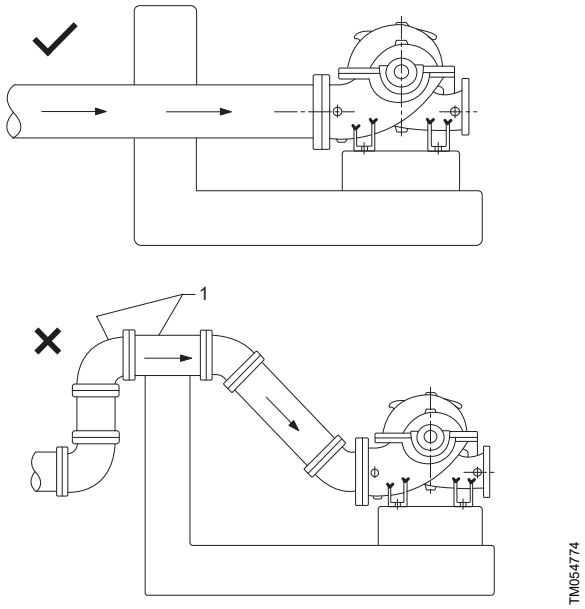


Inlet pipe

1	Eccentric reducer - taper down
2	Concentric reducer

At no point must the diameter of the inlet pipe be smaller than that of the pump inlet port.

3. If possible, run a horizontal inlet line along an even gradient. We recommend a gradual upward slope to the pump under suction lift conditions, and a gradual downward slope under positive inlet pressure conditions.
4. Avoid any high points, such as pipe loops, as this may create air pockets (1) and throttle the system, or cause erratic pumping.



Air pocket prevention

5. Install a gate valve in the inlet line to be able to isolate the pump during shutdown and maintenance, and to facilitate pump removal. Where two or more pumps are connected to the same inlet line, install two gate valves to be able to isolate each pump from the line.
6. Always install gate valves or butterfly valves in positions where they can prevent air pockets.

Do not use globe valves, particularly when the NPSH is critical.

7. During pumping operation, the valves on the inlet line must always be fully open.
8. Install properly sized pressure gauges to enable the operator to monitor the pump performance and determine whether the pump conforms to the parameter of the performance curve. If cavitation, vapor binding, or other unstable operating situations occur, the pressure gauges will indicate wide fluctuation in the inlet and outlet pressures.

3.5 Electrical connection

DANGER

Electric shock

Death or serious personal injury

- The electrical installation must be carried out by a qualified electrician in accordance with local regulations and the manuals provided with the electrical accessories.

DANGER

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and cannot be accidentally switched on.

3.5.1 Motors

The motor control circuit must be installed including a motor disconnecting device, a motor short circuit and ground fault circuit interrupter, and a motor controller with overcurrent protection in order to comply with the National Electrical Code.

3.5.1.1 Installing a motor disconnecting device

1. Install a motor disconnecting device that is capable of disconnecting both the controller (motor-protective circuit breaker) and the motor from their source of power.
2. Position the disconnecting device in such a way that the controller (motor-protective circuit breaker) can be seen from the disconnecting device. In all cases, the distance from the disconnecting device to the controller must be less than 50 feet (15.24 m).

In most installations, the disconnecting device is a circuit breaker or fusible disconnect switch.

3.5.1.2 Installing a motor short circuit and ground fault circuit interrupter

A short circuit and ground fault circuit interrupter is usually a circuit breaker or fusible disconnect switch.

1. Select the circuit breaker or fuse in accordance with section 430-52 and table 430-152 of the National Electrical Code.

3.5.1.3 Installing a motor controller with overcurrent protection (magnetic starter)

1. Install these components in accordance with applicable local and state electrical codes in addition to the National Electrical Code.

DANGER

Explosive environment

Death or serious personal injury

- Observe the rules and regulations generally or specifically imposed by the responsible authorities or trade organizations in relation to running powered equipment in an explosive environment.

2. Check that the voltage, phase and frequency of the incoming power source correspond to the voltage, phase and frequency of the motor(s).

The operating voltage and frequency are marked on the motor nameplate.

3. Electrical characteristics must match those specified on the motor nameplate.
4. The electrical connections must be carried out as shown on the motor nameplate or in the wiring diagram on the back of the terminal box cover. If further information is needed, contact the motor supplier.
5. Mount the control panel or the motor-protective circuit breaker(s) close to the pump to provide convenient control and easy installation.
6. Make sure that the starters and overload control devices are suitable for operating the pump motors on the voltage, phase and frequency available. Always follow the control manufacturer's instructions for proper installation and connection.

Grease-lubricated motors are fully lubricated at the time of manufacture and do not require further lubrication if prompt installation follows. If the motor has been in storage for six months or longer, refer to section *Motor lubrication*, and lubricate it before starting.

3.5.2 Variable frequency drive operation

In principle, all three-phase motors can be connected to a variable frequency drive. However, variable frequency drive operation often exposes the motor insulation system to a heavier load and causes the motor to be noisier than usual due to eddy currents caused by voltage peaks.

If in doubt whether the motor supplied can handle variable frequency drive operation, contact the motor supplier.

In addition, large motors driven via a variable frequency drive will be loaded by bearing currents. When the pump is operated via a variable frequency drive, check the following operating conditions:

Operating conditions	Action
2-, 4- and 6-pole motors of 40 hp and up	Check to make sure that one of the motor bearings is electrically isolated. If not, contact Grundfos.
Noise-critical applications	Fit a dU/dt filter between the motor and the variable frequency drive, it reduces the voltage peaks and thus the noise.
Particularly noise-critical applications	Fit a sinusoidal filter.
Cable length	Fit a cable that meets the specifications laid down by the variable frequency drive supplier. The length of the cable between motor and variable frequency drive affects the motor load.
Supply voltage up to 500 V	Check that the motor is suitable for variable frequency drive operation.
Supply voltage between 500 V and 690 V	• Fit a dU/dt filter, it reduces the voltage peaks and thus the noise. • Also, check that the motor has reinforced insulation.
Supply voltage of 690 V and up	• Fit a dU/dt filter, it reduces the voltage peaks and thus the noise. • Also, check that the motor has reinforced insulation.

3.6 Outlet pipe

A short outlet pipe can be the same diameter as the pump outlet port. A long pipe must be one or two sizes larger than the outlet port, depending on the length.

Optimally, long horizontal outlet pipes should be used. Install a gate valve near the outlet port to be able to isolate the pump during shutdown and maintenance, and to facilitate pump removal.

Any high point in the outlet pipe may entrap air or gas, thus impeding pump operation.

If water hammer occurs, when check valves are used, close the outlet gate valve before pump shutdown.

3.7 Shaft seals

The KP pumps are available with stuffing boxes with packing rings or mechanical shaft seals.

3.7.1 Stuffing boxes (KP)

The stuffing boxes are normally packed before shipment.

If the pump is installed within 60 days, the packing material will be in good condition for operation with a sufficient supply of lubricating liquid.

If the pump is stored for more than 60 days, it may be necessary to repack the stuffing boxes.

The stuffing box must be supplied at all times with a source of clean, clear liquid to flush and lubricate the packing rings.

3.7.2 Adjusting the packing gland (KP)

1. Make sure that the flushing fluid lines are connected, and their valves are open.
2. With the pump running, adjust the packing gland to permit 40 or 60 drops per minute for shaft lubrication.
3. Tighten the packing gland evenly to provide uniform compression on the packing material.

Do not operate packing dry, and do not over-tighten the packing gland to eliminate leaking as this causes damage to the shaft sleeve.

After initial startup, additional packing and adjustment may be required.

3.7.3 Mechanical seals

Mechanical shaft seals require no maintenance or adjustment.

KP, KPV, KPVS pumps equipped with mechanical shaft seals are matched to the operating conditions for which the pump has been sold.

Observe the following precautions to avoid shaft seal damage and to obtain maximum shaft seal life:

Do not run the pump dry or against a closed valve. Dry operation will cause shaft seal failure within minutes.

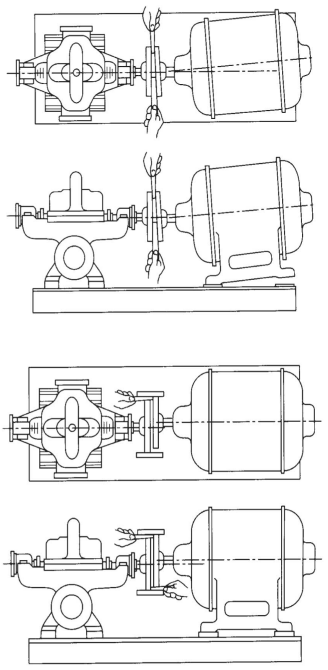
Do not exceed temperature or pressure limitations for the mechanical seal.

- Before operating the pump, purge all air from the seal chambers and recirculation lines.
- Clean and purge the inlet pipe in new installations before installing and operating the pump. Pipe scale, welding slag and other abrasives cause rapid shaft seal failure.
- A mechanical shaft seal does not leak at all during normal operation, therefore, if any noticeable leakage occurs, the seal must be removed, inspected and, if necessary, replaced.

We recommend keeping a stock of spare parts to reduce equipment down time.

3.8 Checking parallel and angular alignment

1. If the pump and motor were shipped mounted on a common base frame as an assembly, remove the coupling guard.
2. Place a straight edge and feeler gauges or a dial indicator across both coupling hubs to check for horizontal, vertical, and angular misalignment of the coupling hubs. See the figure below.



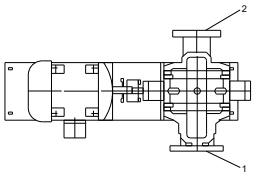
TM054767

KP, checking angular or parallel alignment

Coupling alignment is correct if all points of the coupling faces are within 0.005 inch (0.127 mm) of each other, or when the straight edge contacts both hubs evenly in both horizontal and vertical positions. If misalignment is detected, loosen the motor and shift or shim as necessary to re-align.

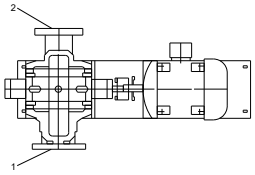
3. Re-tighten the anchor bolts. Always align the motor to the pump, as pipe strain occurs if the pump is shifted. Never reposition the pump on the base frame.

4. Check the shaft alignment once again after final piping connections to the pump are completed, the motor wiring is checked, the correct direction of rotation has been established, and the pipes are filled with liquid. See the figures below (1 - inlet, 2 - outlet).



TM059288

KP, plan view clockwise (CW) rotation



TM059289

KP, plan view counterclockwise (CCW) rotation

WARNING

Moving machine parts or blades

Death or serious personal injury

- Make sure an approved coupling guard is in place before operating the product.

5. Once the priming procedure is completed, install the coupling guards for protection against rotating machinery.

4. Starting up the product

4.1 Priming

KP, KPV and KPVS pumps are non-self-priming and must be completely primed, that is, filled with liquid and vented for air pockets, before starting.

- If the pump is to be operating with a positive inlet pressure, prime it by opening the inlet valve and allowing liquid to enter the pump housing. Open the vents at the top of the upper pump housing and the top of each inlet dome, and make sure that all air is forced out of the pump by the liquid before closing the vents.

  Rotate the shaft by hand while priming to free entrapped air from the impeller passageways.

- If the pump is to be operating with a suction lift, priming must be completed with the help of foot valves, ejectors or vacuum pumps, or by manually filling the pump housing and the inlet line with liquid.

  Never run the pump dry in the hope that it will prime itself. The result will be serious damage to the shaft seals, pump wear rings and shaft sleeves.

4.2 Pre-start checklist

Do not operate the product above the range of the nameplate conditions. This may damage the product.

Complete the following inspections before starting your KP, KPV, or KPVS pumps:

- Make sure that the inlet and outlet pipes have been cleaned and flushed to remove dirt and debris.
- Make sure that all wiring connections to the motor and starting device are in accordance with the wiring diagram, and proper rotation is established.
- If the motor has been in storage for a long time, either before or after installation, refer to the motor instructions before starting the pump.
- Make sure that the voltage, phase, and frequency correspond to the relevant value on the motor nameplate.
- Turn the impeller by hand to make sure that it rotates freely.
- Tighten the plugs in the gauge and drain the holes. If the pump is fitted with pressure gauges, keep the gauge cocks closed when they are not in use.
- Recheck the motor-to-pump alignment as described in section *3.8 Checking parallel and angular alignment*.
- Check inlet and outlet pipes for leaks, and make sure that all flange bolts are securely tightened.
- If the pump is to run on a variable frequency drive, do not ramp up the pump from reduced speeds. Start the pump at full speed, especially at commissioning so adequate pressure is generated to flush wear rings and create a hydrostatic bearing effect.

4.3 Checking the direction of rotation of the motor

Never check the direction of rotation of the motor unless the pump and the motor couplings are disconnected and physically separated. Failure to follow this instruction can result in serious damage to the pump and the motor if the direction of rotation is wrong.

After the unit has been wired and it is made sure ensure that all components in the system, such as disconnect devices, magnetic starters, pilot devices and motors, are properly connected, check the direction of rotation of the motor as follows:

1. Make sure that the coupling is disconnected, then momentarily energize the motors to ensure that the direction of rotation is correct as indicated by the arrow cast into the pump housing.

   If the direction of rotation is incorrect, interchange the two wires at the motor-protective circuit breaker terminals T1 and T2.

2. For Wye-Delta motors, the direction of rotation has to be verified for both the wye and the delta connections.

3. For proper direction of rotation, reference rotation drawing in section *3.8 Checking parallel and angular alignment*.

   The pumps must not be operated while dry. Use extreme caution to only momentarily energize the motors when determining the proper direction of rotation.

4.4 Starting the pump

WARNING

Moving machine parts

Death or serious personal injury

- Mount an approved coupling guard before operating the product.

For KPVS pumps, ensure that the jacking screw (position 114 on the sectional drawing in section *7.5 KP, horizontal, cross-section and parts list*) is firmly seated and sealed by turning it counterclockwise. This will prevent media leakage during operation.

1. Install a coupling guard.
2. Fully open the gate valve (if any) in the inlet line, and close the gate valve in the outlet line.
3. If applicable, turn on any external source of cooling or lubricating fluid to the shaft seals.

4. Fill the inlet line with liquid and completely prime the pump.
5. Start the pump, then immediately make a visual check of the pump and the inlet pipe for pressure leaks.
6. As soon as the pump reaches full operating speed, slowly open the outlet gate valve, and open the bleed valves at the high points of the system.

   Do not open the outlet gate valve completely until the system is full of liquid, purged of air and checked for leaks.

7. After entirely filling the system, fully open the outlet gate valve and close the system bleed valves.
8. If the pump is fitted with pressure gauges, open the gauge cocks and record the pressure readings for future reference. Verify that the pump is performing in accordance with the parameters specified in the performance curves.
9. Check and record the voltage, amperage per phase, and kilowatts, if a wattmeter is available.

5. Handling and storing the product

See section *7.8 Taking the product out of operation*.

6. Product introduction

6.1 Applications

We recommend KP, KPV and KPVS pumps for the following applications:

- circulation in heating and air conditioning systems, water condensing and boiler feed systems
- liquid transfer and pressure boosting in various industrial systems
- water distribution and water treatment in public water systems.

6.2 Pumped liquids

Use clean, thin, non-aggressive liquids, not containing solid particles or fibers. Do not pump liquids that can attack the pump materials chemically.

When pumping liquids with a density and/or viscosity higher than that of water, pressure and flow will be reduced. Alternatively, use motors with correspondingly higher outputs.

The stuffing box packing rings or the mechanical shaft seal O-rings must be suitable for the liquid to be pumped.

Special stuffing box packing rings or shaft seal O-rings may be required if the pump is used for pumping treated water:

- at temperatures above 176 °F (80 °C)
- containing additives to prevent system corrosion, calcareous deposits, etc. (this may be the case in heating and ventilating systems).

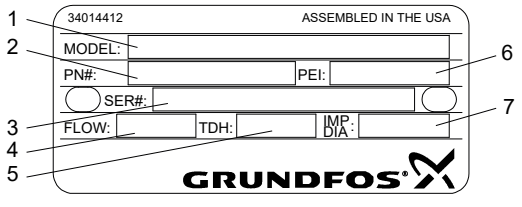
When pumping liquids other than water, select an appropriate stuffing box or shaft seal. For further information, please contact Grundfos.

The maximum operating temperature for the pump is 275 °F (135 °C).

6.3 Pump identification

All PACO pumps are identified by catalog and serial numbers. These are stamped on the pump nameplate, as shown on the figure KP, KPV, KPVS nameplate under the section *6.3.1 Nameplate*, affixed to the pump housing. Refer to these numbers in all correspondence with Grundfos.

6.3.1 Nameplate



KP, KPV, KPVS nameplate

1	Model code
2	Product number
3	Serial number
4	Nominal flow rate [US gpm]
5	Total dynamic head [ft]
6	Pump energy index
7	Impeller diameter [in]

6.3.2 Construction code and type key

Example: 29-60123-140001-1852

Product code	Model code	Construction materials	Motor code
29	-60123	-140001	-1852

Product code

Code	Description
29	Split case (KP, KPV)
31	Split coupled split case (KPVS)

Model code

Pump outlet	
Code	**Description**
10	10"
12	12"
14	14"
16	16"
20[1]	20"
24	24"
20[1]	2"
30	3"
40	4"
50	5"
60	6"
80	8"

1 Code 20 describes 2" outlet on pumps with 13" impellers or below, while refers to 20" outlet on pumps with impellers above 13".

Nominal Maximum Impeller Diameter	
Code	**Description**
12	12"
13	13"
14	14"
15	15"
19	19"
20	20"
24	24"
25	25"
27	27"
28	28"
95	9.5"

Impeller design	
Code	**Description**
1, 3, 5, 7, 9	Clockwise rotation
0, 2, 4, 6, 8	Counterclockwise rotation

Materials of construction

Packing or seal	
Code	**Description**
1	Type 21, single seal, ceramic seat, Buna
2	Type 21, single seal, Tungsten carbide seat, Viton
3	Standard packing
6	Type 21, single seal, Ni-Resist seat, Viton
7	Type 21, single seal, Ni-Resist seat, Buna
8	Type 1B, single seal, Ni-Resist seat, Buna
9	Type 21, single seal, Ni Resist seat, Viton
A	Type 1, single seal, ceramic seat, Buna
B	Type 1, single seal, Ni-Resist seat, Viton
C	Type 1, single seal, Tungsten Carbide seat, Viton
D	Type 1, single seal, Ni Resist seat, Buna
E	Type 1, single seal, ceramic seat, Buna
F	Type 1, single seal, Si Cbrd seat, EPDM
G	Type 8-1, single seal, Si C brd seat, Viton
H	Type 8-1, single seal, ceramic seat, Buna

Inside diameter of packing or seal	
Code	**Description**
2	1"
3	1.25"
4	1.75"
5	2.25"
6	2.75"
7	3"
B	4.7"
E	1.5"

Inside diameter of packing or seal	
Code	**Description**
H	4.1"
K	3.5"
N	5.5"
V	4"

General configuration (Horizontal)	
Code	**Description**
00	Standard
01	Double wear rings
02	Oil lube bearings
03	(01) + (02)
04	(01) + (05)
05	Recirculation lines
20	Double ext shaft
21	Double wear rings
22	Recirculation lines
24	(21) + (22)
30	Double ext shaft
31	Double wear rings
32	Recirculation lines
34	(31) + (32)
70	250 lb flange
71	Double wear rings
72	(71) + (73)
73	Recirculation lines
90	250 lb flange
91	Double wear rings

General configuration (Vertical)	
Code	**Description**
50	Standard (Vesconite for KPVS)
51	Double wear rings
52	Sleeve bearing
53	(51) + (52)
80	250 lb flange for 300 psi CWP
81	Double wear rings
82	Sleeve bearing
83	(81) + (82)
92	250 lb flange for 400 psi CWP
93	Double wear rings
94	Sleeve bearing
95	(93) + (94)

Shaft/Sleeve metallurgy	
Code	**Description**
0	Steel/bronze
1	Steel/stainless steel
3 [1]	Stainless steel/bronze
6	Stainless steel/stainless steel or stainless steel/no sleeves (KPVS)
7	SS/hardened stainless steel
A	316 SS/Ni Al Bronze
X	Special

1 For packed pumps only (standard with distribution ring, recirculation lines, and hardened stainless steel sleeves).

Pump metallurgy	
Code	**Description**
0	Standard fitted
1	Bronze fitted
2	Standard all bronze
5	All iron
8	Ductile iron/bronze fitted
E	Ductile iron/stainless steel fitted
X	Special

Motor code

Enclosure	
Code	**Description**
1	ODP
2	TEFC
3	Explosion Proof

Voltage	
Code	**Description**
01	25 hp, 3 - 200 V
02	30 hp, 3 - 200 V
03	40 hp, 3 - 200 V
04	50 hp, 3 - 200 V
05	60 hp, 3 - 200 V
06	75 hp, 3 - 200 V
07	100 hp, 3 - 200 V
21	0.33 hp, 1 - 115/230 V
23	0.33 hp, 3 - 200 V
24	0.33 hp, 3 - 230/460 V
29	0.5 hp, 1 - 115/230 V
31	0.5 hp, 3 - 200 V
32	0.5 hp, 3 - 230/460 V
35	0.75 hp, 1 - 115/230 V
37	0.75 hp, 3 - 200 V
38	0.75 hp, 3 - 230/460 V
41	1 hp, 1 - 115/230 V
43	1 hp, 3 - 200 V
44	1 hp, 3 - 230/460 V

Voltage	
Code	**Description**
47	1.5 hp, 1 - 115/230 V
49	1.5 hp, 3 - 200 V
50	1.5 hp, 3 - 230/460 V
53	2 hp, 1 - 115/230 V
55	2 hp, 3 - 200 V
56	2 hp, 3 - 230/460 V
59	3 hp, 1 - 115/230 V
61	3 hp, 3 - 200 V
62	3 hp, 3 - 230/460 V
65	5 hp, 1 - 115/230 V
67	5 hp, 3 - 200 V
68	5 hp, 3 - 230/460 V
71	7.5 hp, 1 - 115/230 V
73	7.5 hp, 3 - 200 V
74	7.5 hp, 3 - 230/460 V
76	10 hp, 1 - 115/230 V
77	10 hp, 3 - 200 V
78	10 hp, 3 - 230/460 V
81	15 hp, 3 - 200 V
82	15 hp, 3 - 230/460 V
84	20 hp, 3 - 200 V
85	20 hp, 3 - 230/460 V
87	25 hp, 3 - 230/460 V
88	30 hp, 3 - 230/460 V
89	40 hp, 3 - 230/460 V
90	50 hp, 3 - 230/460 V
91	60 hp, 3 - 230/460 V
92	75 hp, 3 - 230/460 V
93	100 hp, 3 - 230/460 V
94	125 hp, 3 - 230/460 V
95	150 hp, 3 - 230/460 V
96	200 hp, 3 - 230/460 V
97	250 hp, 3 - 230/460 V
98	300 hp, 3 - 230/460 V

RPM	
Code	**Description**
1	3500
2	1750
3	1150

7. Servicing the product

7.1 Maintaining the product

7.1.1 Motor lubrication

DANGER

Moving machine parts

Death or serious personal injury

- Before any inspection, maintenance, service or repair of the product, make sure that the motor controls are in the "OFF" position, locked and tagged.

Always follow the motor manufacturer's lubricating instructions, if available, and periodically check grease fittings and drain plugs for leaks. If lubricating instructions are not available, refer to the table below for recommended lubricating intervals.

The motor can be lubricated both when it is running and when it is at rest. Remove the grease drain plug (if any) and filler plug on the grease fitting. Grease with clean lubricant until grease appears at the drain hole or along the motor shaft.

Recommended lubricating intervals

Motor rpm	Motor hp	Operating conditions		
		Standard	Severe	Extreme
1750 and below	10-150	1-3 years	6 months - 1 year	6 months - 1 year
	200 and up	1 year	3 months	1 month
above 1750	All hp	1 year	3 months	1 month

Standard conditions:

The motor operates 8 hours per day, with normal or light load, in clean air, at 100 °F (37 °C) maximum ambient temperature.

Severe conditions:

The motor operates continuously 24-hours, with shock loads or vibrations, in poor ventilation, at 100-150 °F (37-65 °C) ambient temperature.

Extreme conditions:

The motor operates continuously, with heavy shocks or vibrations, and dirt or dust in the air, at extremely high ambient temperature.

The table below lists the recommended types of grease for motor lubrication. These types have all been thoroughly tested and must be used whenever possible.

Recommended bearing grease for motors

Manufacturer	Bearing lubricant
Chevron	SRI grease NLGI No. 2
Texaco	Polystar RB2 NLGI No. 2

7.1.2 Lubrication of the pump bearings

WARNING

Catastrophic failure

Death or serious personal injury

- Maintain proper lubrication schedule.
- Do not operate the unit without proper lubrication as this can result in overheating of the bearings, bearing failures, pump seizures and actual breakup of the equipment, exposing operating personnel to personal injury.

Recommended bearing grease for pumps

Manufacturer	Lubricant
Shell	Gadus S2
ExxonMobil	Polyrex®
Chevron	SRI Grease NLGI 2
	Black Pearl NLGI 2
Phillips 66	Polytrac EP 2
Texaco	Polystar RB2 NLGI No. 2

Regreasable bearings are packed with grease prior to shipping. This initial filling of grease is sufficient for one year or 2000 hours of normal operation, whichever concludes first. After one year or 2000 hours of normal operation, a regular grease maintenance schedule must be implemented.

7.1.3 Replacing grease (KP, KPV)

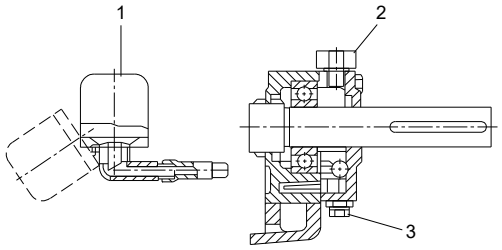
1. Remove the 4 cap screws and remove the bearing covers (113C and 113D) to allow access to the bearing.
2. Use a clean rag to remove as much old grease as possible from the bearing.
3. Re-pack the bearing with sufficient grease to completely cover the balls inside the bearing.
4. Turn the pump shaft to ensure even and complete lubrication.
5. For drive end bearing maintenance, slide the bearing cover back as far as possible and visually inspect the bearing for grease.
6. Proceed with removing old grease with a clean rag. If the bearing covers cannot be moved sufficiently to allow access to the bearing, remove the coupling hub.
7. Reinstall the bearing covers when finished.

Do not over-grease! Too much grease can cause overheating and premature bearing failure.

Bearing manufacturers recommend that you fill the bottom third of the bearing with grease. After filling the bottom third with grease, rotate the shaft to cover the balls inside the bearing.

7.1.4 Oil-lubrication (KP, KPV)

Follow a regular oil maintenance program. KP and KPV pumps with oil-lubricated bearings are fitted with a transparent reservoir, a constant-level oiler, that maintains the oil level around the center line of the lower bearing. See position 1 in the figure below. When necessary, renew the oil supply in the reservoir of the constant-level oiler. To refill it, remove the reservoir and fill it with oil. After filling the reservoir with oil, place it back into operating position.



Oil-lubricated bearing construction

1	Reservoir of the constant-level oiler
2	Filler plug
3	Drain plug

Change the oil after the first 200 hours of operation. To change the oil, remove the drain plug (3) at the bottom of the bearing cover and the filler plug (2) at the top of the bearing frame. After draining the oil, replace the fittings and refill the reservoir with an oil selected from the table below (List of acceptable oil lubricants). After the first oil change, the oil must be changed again at 2000 hours and then at intervals of 8000 hours or once a year thereafter.

List of acceptable oil lubricants	
Lubricant manufacturer	**Bearing oil brand name**
Aral AG	Aral Degol BMB 100
Castrol	Alpha SP 100
Chevron	Meropa 100
ExxonMobil	Mobil Vacuoline 100
Fina Oil Company	Carter SP 460
Gulf Refining	Industrial EP 100
Shell Oil Company	Morlina S1
Sunoco Oil Company	Sunep 100
Texaco	Texaco Ursa Oil P 20
Fuchs Lubricants Co.	Renolin IGL 9

7.1.5 Stuffing box (packing) or shaft seal water lubrication (KP)

The stuffing (packing) box must be continuously supplied with a source of clean, clear liquid to flush and lubricate the packing. Only as much sealing liquid is required that can create a direction of flow from the stuffing box into the pump casing. Pipe from the pump outlet dome to the packing box is supplied upon request.

7.1.6 Maintaining packing (KP)

1. Pack the stuffing box with fresh packing before the initial startup, after each repair of the pump, and in case of excessive leaks. Any time the packing is replaced, inspect the shaft sleeves for wear, roughness or scouring, and replace them if necessary.
2. For instructions on filling the stuffing box see section *Replacing packing on each side*. For seal gland adjustment, see section *Bearing, seal and packing replacement for KP pump*.

7.1.7 Flexible coupling maintenance (KP, KPV)

The coupling is pre-greased at the factory. After dismantling, it must be greased again. For annual greasing, refer to the coupling manufacturer's instructions.

7.2 Dismantling the pump

7.2.1 Preparing for dismantling the pump

DANGER

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply is switched off and cannot be accidentally switched on.

CAUTION

Toxic material

Minor or moderate personal injury

- Wash down the pump before doing any work on it.

WARNING

Hot, caustic, flammable or toxic materials, including vapors

Death or serious personal injury

- Be extremely cautious when venting and/or draining hazardous liquids.
- Wear protective clothing when there are caustic, corrosive, volatile, flammable, or hot liquids.
- Do not breathe in toxic vapors.
- Do not allow sparks, open fire, or hot surfaces near the equipment.

KP, KPV and KPVS pumps are designed for easy maintenance and, as such, the seals, sleeves, wear rings, and bearings can be inspected without having to remove the complete rotating element or having to disconnect the inlet or outlet pipes, or disturbing the alignment of the pump set.

WARNING

Moving machine parts

Death or serious personal injury

- Do not insert a screwdriver between the impeller vanes to prevent rotation.

Work on this equipment is to be performed only by qualified personnel. Read the following instructions thoroughly before performing any work on the pump.

Before starting to dismantle the pump, proceed as follows:

1. Close the inlet and outlet isolation valves.
2. Turn off any external source of cooling or lubricating fluid to the shaft seals.
3. Drain the pump case by opening the drain plug, and vent plugs.
4. Disconnect and lock off the motor power source.

A clearance of 24 inches (610 mm) on each side of the pump allows for maximum access while servicing. A minimum of 24 inches (610 mm) clearance is required to remove the upper pump housing when accessing the rotating element.

7.2.2 Bearing, seal and packing replacement for KP pump

All normally required parts for KP pumps are available in kit form.

Refer to figures *KP, horizontal, cross-section and parts list* and *KPV, vertical, cross-section and parts list*.

7.2.2.1 Replacing the bearing

Refer to the sectional drawings *KP, horizontal, cross-section and parts list* and *KPV, vertical, cross-section and parts list* to determine the position numbers.

1. Remove the motor.
2. Remove the coupling half from the pump shaft (51) using a wheel puller, and remove the coupling key (11A).
3. Remove the bearing covers (113C and 113D).
4. Loosen the set screws in the eccentric locking rings of the bearings (53 and 54) and turn the rings in the opposite of the direction of rotation to loosen from the shaft, or remove the retaining snap ring, whichever is applicable.
5. Remove the cap screws from each bearing housing (124) and, together with the bearing, slide off its end of the shaft.

   Make sure that the seal seats in the bearing housings of seal-type pumps are not broken during housing removal.
6. Remove the bearings (53, 54) from the bearing housings.
7. Install the new seals and seal seats.

8. Reinstall the bearing housings without the bearings, making sure that the slinger (79) is in the correct position. Be careful not to break the seal seats of the seal-type pumps by striking them against the shaft.
9. Clean out the bearing housings and slide the new bearings over the shaft and into the bearing housings. Press only on inner race of the bearing. Use a bearing warmer, if available.
10. Turn the eccentric locking rings in the direction of pump rotation to tighten on the shaft, and tighten the set screws, or replace the spacer and the retaining snap ring, whichever is applicable.
11. Pack the ball bearings and bearing cover cavities with clean ball bearing grease. See section *Lubrication of the pump bearings*.
12. Replace the bearing covers (113C, 113D).
13. If applicable, replace the packing glands after following the packing instructions in section *Replacing packing on each side*.
14. Gently tap the coupling half on the shaft (51) over the key (11A). Do not tap it if it can be pushed on. Using too much force to drive on the coupling half can damage the ball bearings and/or fracture the seal faces. If there is difficulty pushing the coupling onto the shaft, heat up the coupling half to a temperature of not more than 300 °F (148 °C) and then use protective gloves to slide the coupling half onto the shaft.
15. Replace the motor and realign.

On vertically mounted pumps, the rotating assembly has to be removed for replacing the lower bearing and seal assembly.

7.2.2.2 Replacing the mechanical seal

Refer to the sectional drawings *KP, horizontal, cross-section and parts list* and *KPV, vertical, cross-section and parts list* to determine the position numbers.

1. Follow the steps in section *Replacing the bearing* to remove the bearing housings (124).
2. Remove the old seal head and the seal seat from the shaft sleeve and bearing housing or seal cap.

It is not necessary but recommended to remove and replace the bearings from the bearing housings.

3. Inspect the shaft sleeves (116) for scoring or pitting.
4. Replace the shaft sleeves if their surface is rough to your fingernail.

7.2.2.3 Installing proper seal seat

1. Clean the seal cap or bearing housing (124).
2. Lightly lubricate the rubber cap of the new seat with liquid soap.
3. Press in the seal seat into the seal housing, making sure the seat is seated squarely and all the way into seal cap or bearing housing.

Do not touch the seal seat or the head faces.

7.2.2.4 Installing proper seal head

Refer to the sectional drawings *KP, horizontal, cross-section and parts list* and *KPV, vertical, cross-section and parts list* to determine the position numbers.

1. Clean and lightly lubricate the shaft sleeves (116) or the shaft (51). Make sure that there are no sharp edges or corners that could cut the rubber parts of the seal.
2. Lightly lubricate the seal face elastomers with liquid soap.
3. Slide the assembly onto the sleeve or shaft until the spring touches the shoulder. Do not compress the spring. Make sure that the notches on the carbon ring match the lugs of the retainer, and the spring is in position on the seal head.
4. Reinstall the bearing housings (124) with bearings, making sure that the slingers (79) are in correct position. Be careful not to strike the seal seats against the shaft.
5. Continue with the steps of section *Replacing the bearing* to complete the assembly.

7.2.2.5 Replacing packing on each side

1. Remove the packing gland.
2. Remove the old packing distribution ring, if any, and use a packing hook to remove the packing behind the distribution ring.
3. If the packing retainer comes out, place it back against the retaining ring.
4. Insert two new packing rings, one at a time, staggering the joints 180 degrees, and pushing them firmly back against the packing retaining washer.
5. Insert the distribution ring, if any.
6. Insert three more packing rings (applies to most sizes), staggering the joints 180 degrees. If no distribution ring is used, one extra packing ring is required.
7. Replace the packing gland.
8. Adjust the packing gland to permit a leakage of 40 to 60 drops per minute for shaft lubrication.
9. Never overtighten the packing gland. For suction lift applications, should it become necessary to overtighten the packing while starting the pump, make sure to loosen the packing immediately after the pump is started, allowing a leakage of a 40 to 60 drops per minute. After initial startup, additional packing and adjustment may be required.

7.2.3 Replacing bearing and seal for KPVS pumps

Refer to the sectional drawing *KPVS, vertical split coupling split case, cross-section and parts list* to determine the position numbers.

1. Remove the coupling guard and the coupling. See section *Removing the coupling guard*.
2. Remove the seal housing cap screws and the seal housing (124a).
3. Remove the seal head assembly (105) from the shaft (51). Apply water-soluble lubricant to the shaft to facilitate the removal of the seal head. Pull the seal head assembly from the shaft, using a slight twisting motion, if necessary, to loosen the bellows from the shaft.
4. Discard the old seal, spring, and retainer.
5. Remove and discard the old seal seat and gasket from the seal housing (124a), and thoroughly clean the inside cavity of the seal housing and flange.

The inside surface of the bellows on the new shaft seal is coated with a bonding agent that adheres to the pump shaft. When the old shaft seal is removed, the bellows may crack or split during removal. We recommend that you install a new mechanical shaft seal if it becomes necessary to remove the existing shaft seal from the shaft.

6. Clean and lubricate the shaft (51) with a water-soluble lubricant, and make sure that no sharp edges could cut or scratch the bellows of the new shaft seal.
7. Install the new gasket onto the seal housing.

7.2.4 Dismantling horizontal pumps (KP)

Refer to the sectional drawing *KP, horizontal, cross-section and parts list* to determine the position numbers.

1. Remove the nuts and bolts that hold the pump housing halves together (6A, 6B), and remove the cap screws holding the bearing housing (124) to the pump housing.
2. Remove the roll pin (26B) then lift off the upper pump housing (6A).
3. Place the gaskets in water to keep them from drying out and shrinking.
4. Remove the shaft assembly from the case.
5. To dismantle the rotating assembly, refer to section *Replacing the bearing*.
6. Unscrew and remove the shaft sleeves (116) or the impeller locknuts by turning them in the direction of the pump rotation. One has RH (right-hand) threads. The other has LH (left-hand) threads. Use a strap wrench. Do not place the wrench on the part of the sleeve that comes in contact with the seal or packing.
7. Remove the wear ring retaining parts as necessary, locking the pin (24) and/or the rings (65).
8. Slide the wear ring (45) off the impeller.
9. Make an orientation mark on the impeller (49) on the coupling side before removing it from the shaft, to facilitate correct assembly.
10. Press the impeller (49) from the shaft (51) and the key (11). It is not necessary to remove the bearings from the bearing housings. However, we recommend that you replace the bearings.

7.2.5 Dismantling vertical pumps (KPV)

Refer to the sectional drawing *KPV, vertical, cross-section and parts list* to determine the position numbers.

1. Remove the coupling guard and the coupling grid.
2. Remove all the cap screws on the bearing housings (124), except for the two on the lower pump housing (6B) to hold the rotating assembly in place while removing the upper pump housing (6A).
3. Remove the roll pin (26B) then lift off the upper pump housing (6A).
4. Place the gaskets in water to keep them from drying out and shrinking.
5. Remove the shaft assembly from the pump housing.
6. To dismantle the rotating assembly, refer to section *Replacing the bearing*.

7.2.6 Inspecting the components

Refer to the sectional drawings *KP, horizontal, cross-section and parts list* and *KPV, vertical, cross-section and parts list* to determine the position numbers.

1. When dismantling the pump, inspect all components for wear, damage, deterioration or erosion.
2. Inspect the shaft sleeves and replace them if they are worn or deeply scored.
3. Check the impeller wear ring (if used) and the pump housing wear ring (45) for erosion or wear, and replace them if necessary, to restore the original pump performance. The design clearance is 0.018 - 0.022 inch (0.457 - 0.558 mm) diametrically. Clearances over 0.040 inch (1.016 mm) affect pump performance and thus new wear rings must be installed.
4. Examine the lapped faces of the mechanical seals for scoring, heat checking or cracking. Examine mechanical seal elastomers (rubber components) for deterioration or hardening. In case of any damage, replace the mechanical seals.
5. Check any external source of cooling or lubricating fluid lines, and/or recirculation lines and ports for clogs, kinks or other blockages.
6. Clean the machined mating surfaces of all components to remove grit, grime and/or old sealing material before reassembling pump.

7.3 Reassembling the pump (KP, KPV, KPVS)

Refer to the sectional drawings *7.5 KP, horizontal, cross-section and parts list*, *7.6 KPV, vertical, cross-section and parts list* and *7.7 KPVS, vertical split coupling split case, cross-section and parts list* to determine the position numbers.

1. Reinstall the impeller (49) and the key (11) on the shaft (51), centering the impeller on the shaft with respect to the sleeve or the lock nut threads. Make sure that the impeller is installed on the shaft according to the orientation mark made during dismantling the product. For proper rotation, see figures 10 and 11.

   The pump will deliver little or no water if the impeller is installed backwards.

2. Replace the shaft sleeves (116) or nuts, turning them in the opposite direction of the pump rotation. Do not place a wrench on the part of the sleeve that comes in contact with the seal or the packing. Tighten evenly so the impeller position does not shift.

   Make sure that a good O-ring gasket is placed on each sleeve if the shaft has sleeves. Replace as necessary.

3. Replace the retaining ring of the wear ring (65) over the wear ring (45).
4. Slide the wear ring (45) over each impeller hub.
5. Replace the wear rings (45) on the impeller (49) with new seals or packing. Carefully replace the bearing housing (124) on the shaft (51) so as not to damage the seal (11B). Place the bearing (54) into the outboard housing and washer and snap ring. Replace the coupling key (11A) with the coupling half.
6. For packing type pumps, follow the steps in section *7.2.2 Bearing, seal and packing replacement for KP pump* then the steps in section *7.2.2.5 Replacing packing on each side*.

7.3.1 Dismantling and reassembling of the sleeve bearing

DANGER

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply is switched off and cannot be accidentally switched on.

Refer to the sectional drawings *KPV, vertical, cross-section and parts list* and *KPVS, vertical split coupling split case, cross-section and parts list* to determine the position numbers.

7.3.1.1 Dismantling the sleeve bearing

1. Before starting dismantling, close the inlet and outlet side valves.
2. Disconnect all electrical connections, then remove the motor.
3. Remove the coupling guard and the coupling grid.
4. Drain the pumped liquid from the pump. The pipe plug (20A) and the recirculation lines can be used for draining.
5. Remove the bearing covers (113C and 113D).
6. To remove the bearings from the shaft loosen the set screws in the eccentric locking rings of the bearing (53), and turn the ring in the opposite direction of the pump rotation to loosen on the shaft, or remove the retaining snap ring, or the lock nut and lock washer, whichever is applicable.
7. Remove all the cap screws on the bearing housings (124) except for the two on the lower pump housing (6B) to hold the rotating assembly in place while removing the upper pump housing (6A).
8. Remove the roll pin (26B) then lift off the upper pump housing (6A).
9. Place the housing gasket, and all the other gaskets, in water to keep them from drying out and shrinking.
10. Remove the shaft assembly from the pump housing.
11. Remove the sleeves and then the impeller.

7.3.1.2 Reassembling the sleeve bearing

1. Using an appropriately rated sling and overhead lifting equipment, place the pump housing assembly on a flat surface. Remove the hex head bolts.

   If required, clean both of the machined faces on the pump housing assembly with fine grit sand paper.

2. Remove the two roll pins from the lower pump housing. Using an appropriate eyebolt and overhead lifting equipment, remove the upper pump housing and clean it if necessary.
3. Align the two wear rings (45) with the wear ring register in the lower housing. Use a soft-faced hammer and brass punch to drive the roll pins into the drilled holes on the wear ring bores.
4. Slide the wear rings onto the impeller wear rings, ensuring that your hole and roll pin orientation marks are facing outward.
5. Position the impeller (49) in the lower pump housing.
6. Determine the correct rotation (clockwise or counterclockwise).
7. Carefully spray the shaft (51) with solvent, and wipe it off with a clean rag. Install the drive key into the center key slot on the shaft by gently tapping it with a soft-faced hammer.
8. Slide the shaft (51) into the bore of the impeller.
9. Install the lower sleeve (202). Make sure that it engages all the threads. The impeller butts against the lower sleeve or sleeve nut depending the pump size. Install the sleeve and sleeve nut on the other side of the impeller. Use a spanner wrench to secure the sleeves against the impeller hubs.
10. Use an overhead lifting equipment to position the upper pump housing over the four alignment studs and install it onto the lower pump housing. Use a soft-faced hammer to drive the two roll pins into the lower pump housing, and remove the four alignment studs.
11. Place the long cap screws into the mounting holes located in the center area of the upper pump housing, and place the remaining cap screws into the mounted hole located on the flange area of the upper pump housing. Tighten the cap screws uniformly, starting with the four cap screws in the center area.
12. Spray the mounting face surfaces and machined inside diameters of the seal housing with solvent and wipe them off with a clean rag. Carefully align and place the seal seat into the seal housing (124). Slide the seal head assembly onto the in-board or the drive end of the shaft, and seat it up against the shaft sleeve.
13. Carefully slide and position the seal housing so the two blades on the seal housing are oriented at 11 and 1 o'clock. Make sure that you have the slinger on the shaft.
14. Assemble the roller bearing. Secure the bearing cover with screws.
15. Assemble the sleeve bearing housing (which is press fitted with graphalloy sleeve bearing).
16. When the bearing housing is assembled, make sure that the shaft is rotating.
17. Assemble the recirculation lines and the pipe plugs.

7.3.2 Split coupling removal and replacement (KPVS)

7.3.2.1 Removing the coupling guard

1. Shut off the liquid supply to the pump.
2. Remove the coupling guard.
3. Drain the liquid from the pump. The pipe plug on both the top and bottom seal housings can be used to drain the pump.
4. Turn the jacking screw (114) clockwise to engage and support the shaft. Do not raise the height of the shaft to support it at its current location.

   The jacking screw has an O-ring that seals against the seal housing when turned counterclockwise until it runs out of threads.

5. Remove the nuts and bolts from the split coupling (203), and remove each half of the split coupling from the pump and motor shafts.

7.3.2.2 Reinstalling the coupling guard

1. Engage the half of the split coupling with the keyways to the motor shaft and the shaft collar (204).
2. Use the jacking screw (114) to adjust the pump shaft up or down to align the pump shaft groove with the coupling.
3. Engage the coupling fully to both the motor and the pump shafts.
4. Engage the second coupling half to both the motor and the pump shafts.
5. Install the coupling screws and nuts, and tighten to 21 foot-pound.
6. Turn the jacking screw counterclockwise until it bottoms out and seals against the seal housing.
7. Reinstall the pipe plugs into the upper and lower seal housings.
8. Reinstall the coupling guard.

7.3.2.3 Replacing bearing and seal for KPVS pumps

1. Remove the coupling guard and the coupling. See section *Removing the coupling guard*
2. Remove the seal housing cap screws and the seal housing (124a).

3. Remove the seal head assembly (105) from the shaft (51). Apply water-soluble lubricant to the shaft to facilitate the removal of the seal head. Pull the seal head assembly from the shaft, using a slight twisting motion, if necessary, to loosen the bellows from the shaft.
4. Discard the old seal, spring and retainer.
5. Remove and discard the old seal seat and gasket from the seal housing (124a), and thoroughly clean the inside cavity of the seal housing and flange.

The inside surface of the bellows on the new shaft seal is coated with a bonding agent that adheres to the pump shaft. When the old shaft seal is removed, the bellows may crack or split during removal. We recommend that you install a new mechanical shaft seal if it becomes necessary to remove the existing shaft seal from the shaft.

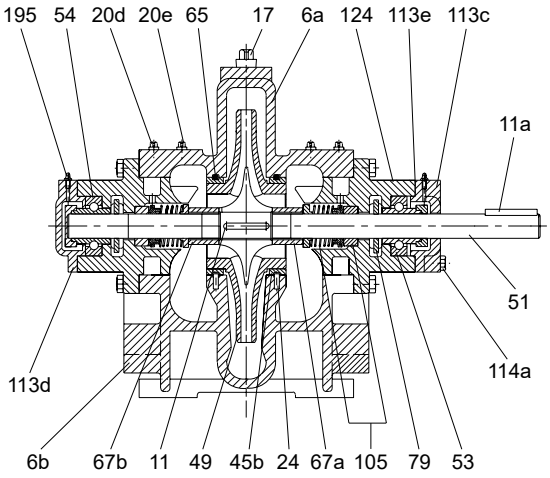
6. Clean and lubricate the shaft (51) with a water-soluble lubricant, and make sure that no sharp edges could cut or scratch the bellows of the new shaft seal.
7. Install the new gasket onto the seal housing.
8. Press the new shaft seal seat firmly into the seal housing. Avoid direct contact between the seal face and metallic or abrasive objects, and wipe the seal face clean after installation to ensure an abrasive-free sealing surface.
9. Slide the new shaft seal assembly onto the shaft by applying even pressure to the base of the assembly.
10. Reinstall the seal housing and screws.
11. Reinstall the coupling and the coupling guard. See section *Reinstalling the coupling guard*.

7.4 Recommended spare parts

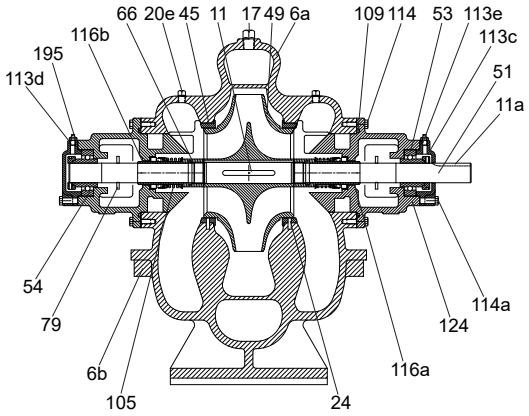
The recommended spare parts depend on the run time and application of the pump. As a minimum, we recommend that you keep the following kits:

- shaft seal kit
- bearing kit
- gasket kit.

7.5 KP, horizontal, cross-section and parts list



KP, Horizontal, cross-section, X2

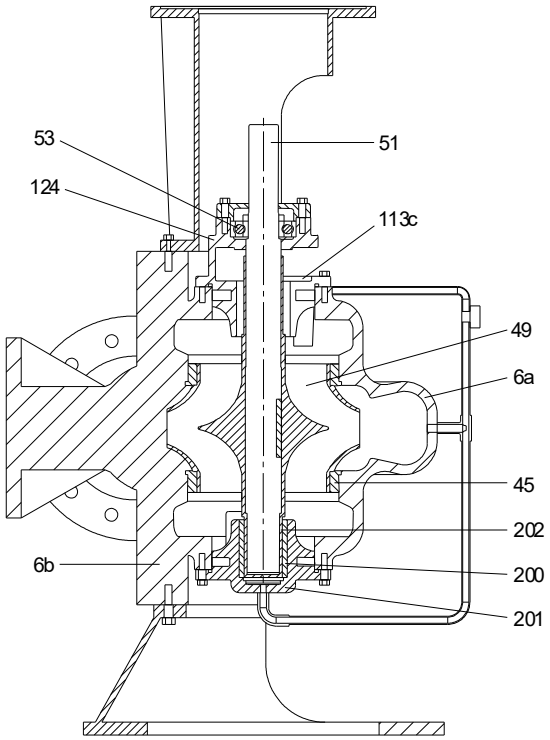


KP, Horizontal, cross-section, X4

Pos.	Component	Material	ASTM standard
6a	Pump housing, upper	Cast iron	ASTM A48 CL35
6b	Pump housing, lower	Cast iron	ASTM A48 CL35
11	Key	Steel	C1018, cold drawn steel
11a	Key	Steel	C1018, cold drawn steel
17	Pipe plug	Steel	
20d	Plug, shaft seal flushing	Steel	
20e	Plug, suction chamber	Steel	
24	Locking pin, wear ring	Steel	ANSI/ASME B18.8
45	Wear ring	Bronze	ASTM B148, C95200
45b	Wear ring with groove for retaining ring	Bronze	ASTM B148, C95200
49	Impeller	Silicon bronze	ASTM B584, C87600
51	Shaft	Steel	AISI 1144 Stress proof
53	Bearing, drive end	Steel	
54	Bearing, non-drive end	Steel	
65	Retaining ring	Stainless steel, series 303	
66	O-ring	NBR	
67a	Impeller/shaft sleeve nut, right-hand (RH) thread	Bronze	lll932, C89835
	Impeller/shaft lock nut, right-hand (RH) thread	Stainless steel	

Pos.	Component	Material	ASTM standard
67b	Impeller/shaft sleeve nut, left-hand (LH) thread	Bronze	lll932, C89835
	Impeller/shaft lock nut, left-hand (LH) thread	Stainless steel	
79	Slinger	Neoprene	
105	Shaft seal		
109	O-ring	NBR	
113c	Bearing cover, drive end	Cast iron	ASTM A48 CL30
113d	Bearing cover, non-drive end	Cast iron	ASTM A48 CL30
113e	Gasket	Vegetable fiber	
114	Screw	Steel	
114a	Screw	Steel	
116a	Shaft sleeve, drive end	Bronze	I836 C89833
116b	Shaft sleeve, non-drive end	Bronze	I836 C89833
124	Bearing housing	Cast iron	ASTM A48 CL30
195	Lubricating nipple	Zinc-coated steel	

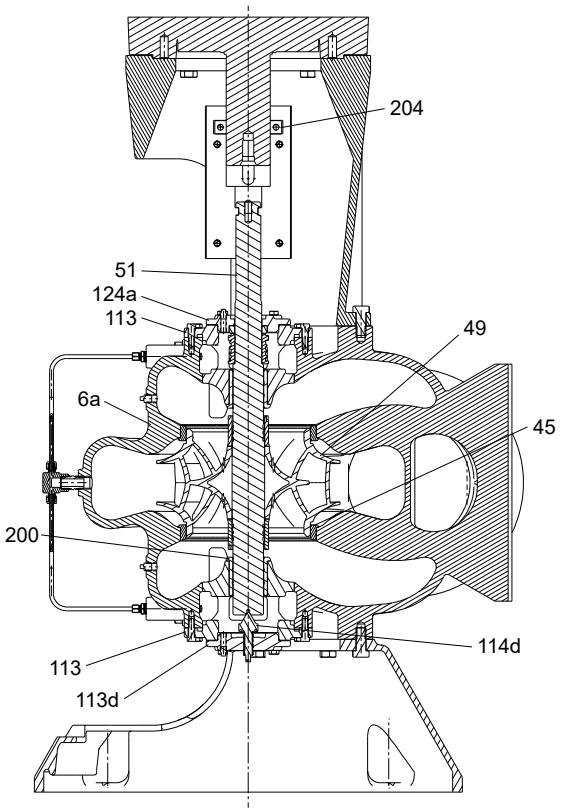
7.6 KPV, vertical, cross-section and parts list



KPV, Vertical, cross-section

Pos.	Component	Material	ASTM standard
6a	Pump housing, upper	Cast iron	ASTM A48 CL35
6b	Pump housing, lower	Cast iron	ASTM A48 CL35
45	Wear ring	Bronze	ASTM B148, C95200
49	Impeller	Silicon bronze	ASTM B584, C87600
51	Shaft	Steel	AISI 1144 Stress proof
53	Ball bearing, drive end	Steel	
113c	Bearing cover, drive end	Cast iron	ASTM A48 CL30
124	Bearing housing	Cast iron	ASTM A48 CL30
200	Sleeve bearing	Graphalloy	Grade GM 343.3
201	Sleeve bearing housing	Cast iron	
202	Lower sleeve	Stainless steel, series 416	

7.7 KPVS, vertical split coupling split case, cross-section and parts list



KPVS, Vertical Split Coupling Split Case, cross-section

Pos.	Component	Material	ASTM standard
6a	Pump housing, upper	Cast iron	ASTM A48 CL35
45	Wear ring	Bronze	ASTM B148, C95200
49	Impeller	Silicon bronze	ASTM B584, C87600
51	Shaft	Steel	AISI 1144 Stress proof
113	Bearing housing	Cast iron	ASTM A48 CL30
113d	Bearing cover, non-drive end	Cast iron	ASTM A48 CL30
114d	Jacking screw		
124a	Seal housing	Cast iron	ASTM A48 CL30
200	Sleeve bearing	Vesconite	
203	Coupling	Aluminum	
204	Shaft collar	Stainless steel	

7.8 Taking the product out of operation

The following shutdown procedures apply for KP and KPV pumps in most normal shutdown situations:

- *7.8.1 General procedure*
- *7.8.2 Short-time shutdown*
- *7.8.3 Long-term shutdown*

If the pump is inoperative for a long time, follow the storage procedures in section *7.8.3 Long-term shutdown*.

7.8.1 General procedure

1. Always close the outlet gate valve before stopping the pump.

   Close the valve slowly to prevent hydraulic shock.

2. Switch off and lock off the power supply to the motor.

7.8.2 Short-time shutdown

1. For overnight or temporary shutdown periods under nonfreezing conditions, the pump can remain filled with liquid. Make sure that the pump is fully primed before restarting.
2. For short or frequent shutdown periods under freezing conditions, keep the liquid moving within the pump housing and insulate it or heat the pump exterior to prevent freezing.

7.8.3 Long-term shutdown

1. For long shutdown periods or to isolate the pump for maintenance, close the inlet and outlet gate valves. If no inlet gate valve is used and the pump has positive inlet pressure, drain all liquid from the inlet line to stop the liquid flow into the pump inlet.
2. If applicable, turn off any external source of cooling or lubricating fluid to the shaft seals.
3. Remove the plugs in the pump drain and vent holes, as required, and drain all liquid from the housing.
4. Remove the packing, if applicable.
5. If there are freezing conditions during long shutdown periods, completely drain the pump and blow out all liquid passages and pockets with compressed air.

   Freezing of the pumped liquid can also be prevented by filling the pump with antifreeze solution.

6. Rotate the shaft by hand monthly to coat the bearings with lubricant to prevent oxidation and corrosion.
7. Follow the motor manufacturer's storage recommendations where applicable.

8. Fault finding the product

DANGER

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply is switched off and cannot be accidentally switched on.

CAUTION

Toxic material

Minor or moderate personal injury

- Wash down the pump before doing any work on it.

DANGER

Hot, caustic, flammable or toxic materials, including vapors

Death or serious personal injury

- Be extremely cautious when venting or draining hazardous liquids.
- Wear protective clothing when there are caustic, corrosive, volatile, flammable, or hot liquids.
- Do not breathe in toxic vapors.
- Do not allow sparks, open fire, or hot surfaces near the equipment.

Fault	Cause	Remedy
1. The outlet pressure is too low.	a) The speed of rotation is too low.	Reestablish the correct speed and direction of rotation.
	b) The system pressure is lower than expected.	Check the system curve.
	c) There is air or gas in the pumped liquid.	Remove the air from the pumped liquid.
	d) The wear rings are worn.	Replace the wear rings.
	e) The impeller is damaged.	Repair or replace the impeller.
	f) The impeller diameter is too small.	Replace the impeller with one of the correct diameter.
	g) The direction of rotation is wrong.	Interchange two wires in the power supply.
	h) The pump has lost its prime.	Re-prime the pump.
	i) There is insufficient NPSH.	Restore the NPSH required.
	j) Passages are restricted.	Clean the impeller and pump housing passages.
	k) The stuffing box or the joints are leaking.	• Tighten the joints or the stuffing box gland. • Replace the shaft sleeve. • Replace the gaskets.
2. The inlet pressure is insufficient.	a) The inlet line is drawing air.	Tighten the connections.
	b) The suction lift is too high or there is insufficient NPSH.	Reduce the suction lift or restore the NPSH required.
	c) Air or gas is trapped in the pumped liquid.	Remove the trapped air or gas from the liquid.
	d) The strainer is clogged.	Clean the strainer.
3. The noise level has increased.	a) Poor alignment of the pump. The inlet and outlet pipe clamps are loose.	• Reestablish proper alignment of the pump and the motor. • Support the inlet and outlet pipes. • Make sure that the vibration dampers, flexible pipes and conduit connectors are installed correctly.
	b) Cracked foundation.	Repair the foundation.
	c) Worn ball bearings.	• Replace the worn bearings. • Renew the lubrication.
	d) The motor is unbalanced.	• Disconnect the motor and operate it alone. • Remove large pieces of debris, such as wood or rags, from the pump. • Clean out the pump if necessary.
	e) Hydraulic resonance.	• Alter the resonant pipes. • Change the pump speed. • Insert a pulsation damper on the pump or the pipes. • Insert a flow straightener.
4. There is insufficient flow.	a) The pump is not primed.	Prime the pump.
	b) The system pressure exceeds the shut-off pressure.	• Increase the liquid level on the inlet side. • Open the isolating valve in the inlet pipe.
	c) The speed of rotation is too low.	Reestablish the correct speed of rotation.

Fault	Cause	Remedy
	d) The suction lift is too high or there is insufficient NPSH.	Reduce the suction lift or restore NPSH required.
	e) The strainer or the impeller is clogged.	Clean the strainer and the impeller passages.
	f) Wrong direction of rotation.	Reestablish the correct direction of rotation.
	g) The joints are leaking.	Tighten the joints.
	h) The shaft or coupling is broken.	Repair or replace the damaged parts.
	i) The inlet valve is closed.	If the inlet valve is closed, open it slowly.
	j) There is not enough inlet pressure for hot or volatile liquids.	Reestablish the required inlet pressure.
	k) The foot valve is too small.	Replace the foot valve.
	l) Worn or damaged hydraulic parts.	Repair or replace the worn parts.
	m) Excessive clearance between the wear surfaces.	Adjust the impeller clearance, if possible, or replace the wear ring.
5. The pump loses its prime after starting.	a) The stuffing box or the joints are leaking.	• Tighten the joints or the stuffing box gland. • Replace the shaft sleeve. • Replace the gaskets.
	b) The suction lift is too high or there is insufficient NPSH.	Reduce the suction lift or restore the NPSH required.
6. Excessive power is required to operate the pump.	a) The speed of rotation is too high.	Reduce the speed of rotation.
	b) The pump is operating beyond its recommended performance range.	Set the duty point in accordance with the recommended performance range.
	c) The specific gravity or viscosity of the pumped liquid is too high.	If less flow is sufficient, reduce the flow on the outlet side, or fit the pump with a more powerful motor.
	d) The shaft is bent.	Replace the shaft.
	e) The stuffing-box is too tight.	Re-tighten the stuffing box if possible. Alternatively, repair or replace the stuffing box.
	f) The impeller clearance is too small, causing rubbing or worn wear surfaces.	Adjust the impeller clearance, if possible, or replace the wear ring.
	g) There is an electrical or mechanical defect in the motor.	Contact your local service center for diagnostics.
	h) The pump is restricted in its rotation.	Remove any obstacles or replace any worn parts.
	i) Incorrect lubrication of the motor.	Reestablish correct lubrication of the motor.

9. Technical data

9.1 Operating conditions

9.1.1 Flow rate

Minimum flow rate

The pump must not run against closed outlet valve as it causes an increase in temperature or formation of steam in the pump. This could cause shaft damage, impeller erosion, short life of the bearings, damage to the stuffing boxes or the mechanical shaft seals due to stress or vibration.

The minimum continuous flow rate is shown when selecting the pump in the Grundfos Express online selection tool.

Maximum flow rate

The maximum flow rate must not exceed the value stated on the nameplate. If the maximum flow rate is exceeded, cavitation and overload could occur.

9.1.2 Ambient temperature and altitude

The ambient temperature and the installation altitude are important factors for the motor life, as they affect the life of the bearings and the insulation system.

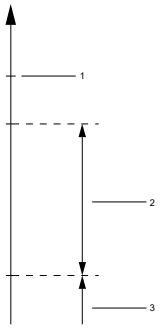
Too high ambient temperature or low density, and consequently low cooling effect of the air, could result in overheating. In such cases, it may be necessary to use a motor with a higher output.

9.1.3 Liquid temperature

The maximum liquid temperature depends on the material of the mechanical shaft seal, O-rings, gaskets and plain bearings used:

Material	Temperature range	
	Farenheit (°F)	Celsius (°C)
BUNA	32–210	0–99
FKM	59–275	15–135
EPDM	59–275	15–135
Vesconite	10–120	−12 – +50
Graphalloy	10–275	−12 – +135

9.1.4 Pressures in the pump



TM040062

Pressures in the KP pump

1	Pressure p stated on the pump (pressure above atmospheric pressure)
2	Pump pressure
3	Inlet pressure

9.1.5 Outlet pressure

Maximum outlet pressure

The maximum outlet pressure (TDH) is the pressure stated on the pump nameplate.

9.1.6 Inlet pressure

Minimum inlet pressure

The minimum inlet pressure must correspond to the NPSH curve for the pump plus a safety margin of minimum 1.6 feet (0.5 m) head.

Pay attention to the minimum inlet pressure to avoid cavitation.

The risk of cavitation is higher in the following situations:

- The liquid temperature is high.
- The flow rate is considerably higher than the rated flow rate of the pump.
- The pump is operating in an open system with suction lift.
- The inlet conditions are poor.
- The operating pressure is low.

Maximum inlet pressure

The sum of the inlet pressure and the pump pressure must be lower than the maximum pressure (TDH) of the pump.

10. Disposing of the product

This product or parts of it must be disposed of in an environmentally sound way. Use the public or private waste collection service. If this is not possible, contact the nearest Grundfos company or service workshop.

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