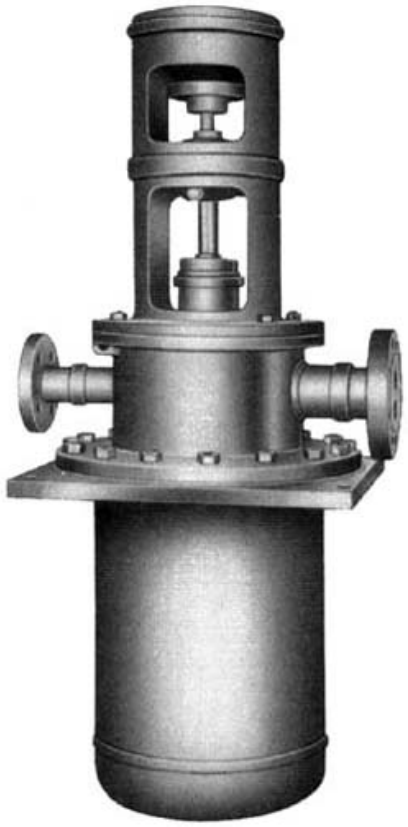
KSB WKT



Vertical Process Pump
according to API 610
as per Directive 94/9/EC

Works Nº: _____

Type series: _____

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

This manual shall always be kept close to the unit´s location of operation or directly on the pump set.

Contents

Introduction

KSB has supplied you an equipment that has been designed and manufactured with the latest technology.
Due to its simple and tough construction, it will need few maintenance. With the aim to provide our clients with a satisfactory, trouble free operation, we recommend to install and care our equipment according to the instructions contained in this service manual.

This manual has been prepared to inform the end user about construction and operation of our pumps, describing the proper procedures for handling and maintenance.
We recommend that this manual should be handled by the maintenance supervision.

This equipment must be used at operation conditions for which it has been selected, such as: flow rate, total head, speed, voltage, frequency and temperature of pumped liquid.

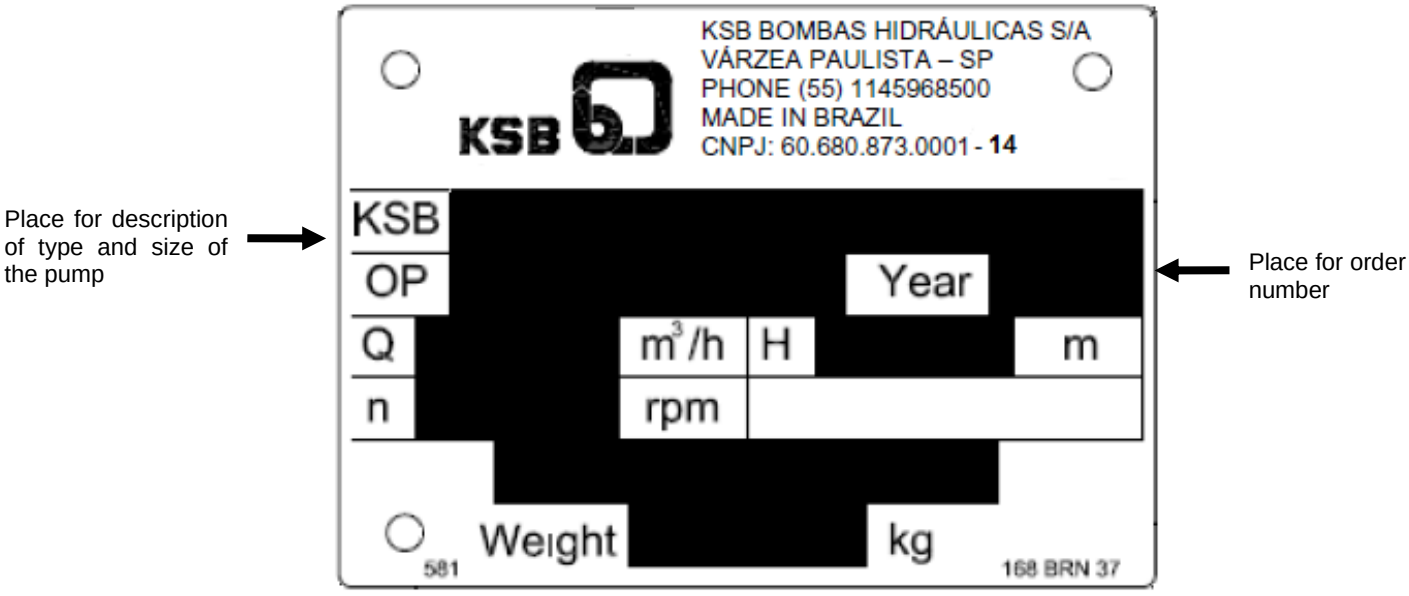


Fig. 01 - Nameplate

For requests about the equipment, or when ordering spare parts, please mention the type of the pump and the Production Order number (serial nº). This information can be obtained from the nameplate of each pump. If the nameplate is not available, the OP number is engraved in low relief on the suction flange and on the discharge flange you may find the impeller diameter.

Attention: This manual contains very important recommendations and instructions. Must be carefully read before installation, electrical connection, first start up and maintenance.

1. General

Caution This KSB product has been developed in accordance with state-of-the-art technology; it is manufactured with utmost care and subject to continuous quality control.
These operating instructions are intended to facilitate familiarization with the unit and its designated use.
The manual contains important information for reliable, proper and efficient operation. Compliance with the operating instructions is of vital importance to ensure reliability and a long service life of the unit and to avoid any risks.
These operating instructions do not take into account local regulations; the operator must ensure that such regulations are strictly observed by all, including the personnel called in for installation.
This pump / unit must not be operated beyond the limit values for the fluid handled, capacity, speed, density, pressure, temperature and motor rating specified in the technical documentation. 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, monitoring 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, particularly if the pump / unit is operated in hazardous areas (see section 2.9).

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 symbol

general hazard sign to ISO 7000-0434

the **electrical danger warning sign** is

safety sign to IEC 417-5036

and special instructions concerning explosion protection are marked

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 a perfectly legible condition at all times.

2.2 Personnel qualification and training

All personnel involved in the operation, maintenance, inspection and installation of the unit 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 / unit itself. Non-compliance with these safety instructions will also lead to forfeiture of any and all rights to claims for damages.

In particular, non-compliance can, for example, result in:
- failure of important machine / system functions;
- failure of prescribed maintenance and servicing practices;
- hazard to persons by electrical, mechanical and chemical effects as well as explosion;
- 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 and international explosion protection regulations, and the operator´s own internal work, operation and safety regulations.
Ex symbol relates to additional requirements which must be adhered to when the pump is operated in hazardous areas.

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 unit is operating.
- Leakages (e.g. at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) must be contained so as to avoid any danger to persons or the environment. All relevant laws must be heeded.
- 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 fluid pumped, especially in the case of abrasive fluids, shall be inspected for wear at regular intervals and replaced by original spare parts (see section 2.7) in due time.

If the pumps / units are located in hazardous areas, it is imperative to make sure that unauthorized modes of operation are prevented. Non–compliance may result in the specified temperature limits being exceeded.

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, pump pressure must have been released and the pump must have been drained.
Work on the machine / unit must be carried out only during standstill. The shutdown procedure described in the manual for taking the unit out of service must be adhered to without fail.
Pumps or pump units handling fluids 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 unit to service.

2.7 Unauthorized modification and manufacture of spare parts

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

2.8 Unauthorized modes of operation

The warranty relating to the operating reliability and safety of the unit supplied is only valid if the equipment 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.

2.9 Explosion protection

If the pumps / units are installed in hazardous areas, the measures and instructions given in the following sections 2.9.1 to 2.9.6 must be adhered to without fail, to ensure explosion protection.

2.9.1 Unit fill

It is assumed that the system of suction and discharge lines and thus the wetted pump internals are completely filled with the product to be handled at all times during pump operation, so that an explosive atmosphere is prevented.

If the operator cannot warrant this condition, appropriate monitoring devices must be used.

Caution In addition, it is imperative to make sure that the seal chambers, auxiliary systems of the shaft seal and the heating and cooling systems are properly filled.

2.9.2 Marking

The marking on the pump only refers to the pump part, i.e. the coupling and motor must be regarded separately. The coupling must have an EC manufacturer’s declaration. The driver must be regarded separately.

Example of marking on the pump part:

Ex II 2 G T1 - T5

The marking indicates the theoretically available temperature range as stipulated by the respective temperature classes. The temperatures permitted for the individual pump variants are outlined in section 2.9.5.
Pumps WKT are designed to meet the requirements of Zone 1 and Category 2 as per EN1127-1 **when sealed by mechanical seal.**

2.9.3 Checking the direction of rotation (see also 6.1.7)

If the explosion hazard also exists during the installation phase, the direction of rotation must never be checked by starting up the unfilled pump unit, even for a short period, to prevent temperature increases resulting from contact between rotating and stationary components.

2.9.4 Pump operating mode

Make sure that the pump is always started up with the suction-side shut-off valve fully open and the discharge-side shut-off valve slightly open. However, the pump can also be started up against a closed swing check valve. The discharge-side shut-off valve shall be adjusted to comply with the duty point immediately following the run-up process (see 6.2).
Pump operation with the shut-off valves in the suction and / or discharge pipes closed is not permitted.

Caution In this condition, there is a risk of the pump casing taking on high surface temperatures after a very short time, due to a rapid temperature rise in the pumped fluid inside the pump.

Additionally, the resulting rapid pressure build-up inside the pump may cause excessive stresses on the pump materials or even bursting.
The minimum flows indicated in section 6.4.5 refer to water and water-like liquids. Longer operating periods with these liquids and at the flow rates indicated will not cause an additional increase in the temperatures on the pump surface. However, if the physical properties of the fluids handled are different from water, it is essential to check if an additional heat build-up may occur and if the minimum flow rate must therefore be increased. To check, proceed as described in section 6.4.5.
In addition, the instructions given in section 6 of this operating manual must be observed.

Both gland packings and mechanical seals may exceed the specified temperature limits if run dry. Dry running may not only result from an inadequately filled seal chamber, but also from excessive gas content in the fluid handled.
Pump operation outside its specified operating range may also result in dry running.
In hazardous areas, gland packings shall only be used if combined with a suitable temperature monitoring device.

2.9.5 Temperature limits

In normal pump operation, the highest temperatures are to be expected on the surface of the pump and distributor casing, at the shaft seal and in the bearing areas. The surface temperature at the pump casing corresponds to the temperature of the fluid handled.
If the pump is heated, it must be ensured that the temperature classes stipulated for the plant are observed.
In the bearing bracket area, the unit surfaces must be freely exposed to the atmosphere.
In any case, responsibility for compliance with the specified fluid temperature (operating temperature) lies with the plant operator. The maximum permissible fluid temperature depends on the temperature class to be complied with.
The table below lists the temperature classes to EN 13463-1 and the resulting theoretical temperature limits of the fluid handled. In stipulating these temperatures, any temperature rise in the shaft seal area has already been taken into account.

Temperature class to EN 13463-1:	Temperature limit of fluid handled
T5	85ºC
T4	120ºC
T3	185ºC
T2	280ºC
T1	Max. 400ºC *)

*) depending on material variant

Safety note:

Caution The permissible operating temperature of the pump in question is indicated on the data sheet. If the pump is to be operated at a higher temperature, the data sheet is missing or if the pump is part of a pool of pumps, the maximum permissible operating temperature must be inquired from the pump manufacturer.
Based on an ambient temperature of 40ºC and proper maintenance and operation, compliance with temperature class T4 is warranted in the area of the rolling element bearings. A special design is required to comply with temperature class T6 in the bearing area. In such cases, and if ambient temperature exceeds 40ºC, contact the manufacturer.

2.9.6 Maintenance

Only a pump unit which is properly serviced and maintained in perfect technical condition will give safe and reliable operation.
This also applies to the reliable function of the rolling element bearings whose actual lifetime largely depends on the operating mode and operating conditions.
Regular checks of the lubricant and the running noises will prevent the risk of excessive temperatures as a result of bearings running hot or defective bearing seals (also see section 6.1.4).
The correct function of the shaft seal must be checked regularly. Any auxiliary systems installed must be monitored, if necessary, to make sure they function correctly.
Gland packings must be tightened correctly, to prevent excessive temperatures due to packings running hot.

3. Transport and interim storage

3.1 Transport

The transport of motor-pump set or only pump should be made with ability and sound sense, according to safety standards. By the motor eyebolt should only lift it, never the motor-pump set.

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

Vertical pumps up to about 4 m shipping length are dispatched completely assembled. Larger pumps are dispatched in sub-assemblies and must be assembled at site under KSB´s supervision only.
The stuffing box is not packed and the packing is supplied loose.
The barrel is normally supplied loose with the pump.
To avoid damage in transit, the motor is usually not mounted before dispatch.
Please refer packing list received with the pump for more details.

3.2 Interim storage (indoors) / Preservation

KSB standard storage and preservation procedures maintain the pump protected for a maximum period of 6 months in an indoor installation. The unit / pump should be stored in a dry room where the atmospheric humidity is as constant as possible. When this period is exceeded, additional storage procedure should be taken. For that, please use the following conservation liquids:

- Internal parts of ferrous material in contact with pumped liquid (except mechanical seal contact surfaces): water repellent of mineral oil basis.
- Bearings: mineral oil for internal conservation.
- Polished parts: mineral oil for internal and external conservation.
- Mechanical seals: should be cleaned by dry air. Do not apply any liquid or other conservation material in

order to not damage secondary sealings (O´rings and flat gaskets).

All existing connections, like plugs for external source liquid, priming, drainage, etc, should be properly covered.
Pump suction and discharge flanges are properly covered with adhesive, in order to avoid strange contents in its interior.
Assembled pumps waiting for startup or installation should have their rotor manually rotated each 15 days. In case of difficulty, use some adjustable spanner, protecting the motor shaft surface.
Before conservation liquids application, areas should be washed with gas or kerosene until they are completely cleaned.
The conservative liquids can be removed from the areas in contact with pumped liquid, polished parts and surfaces like: shaft, salient faces and couplings, by means of solvents derived from petroleum or clean industrial liquids. Drain the conservative oil from bearing bracket before fulfill it with lubricant oil.

3.3 Devolution / discard

3.3.1 Devolution

- Drain the pump correctly.
- Carefully wash and clean the pump, especially in case of harmful, explosive, hot fluids or other hazardous fluids.
- In the case fluids are pumped, and they are with residues which can cause corrosion damage when in contact with atmospheric humidity or that can ignite in contact with oxygen, the pump aggregate must be additionally neutralized and its dry process must be executed through blowing inert gas without water through the aggregate.
- Should always be sent with the pump / motor pump set a certificate of decontamination completely fulfilled. (Annex 1).
- Please always indicate adopted safety and decontamination measurements.

3.3.2 Discard

	**CAUTION** Medium handled is harmful to health. Hazardous for people and environment! ✓ Collect and dispose of the liquid from the washing as well as any residual liquids. ✓ If necessary, use protective clothing and mask. ✓ Observe the legal disposals related to the discard of harmful liquids to health.

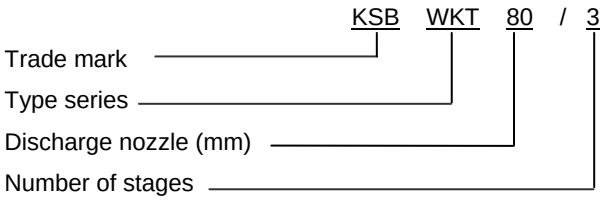
- Disassemble the pump / moto-pump set.
  Collect the masses and lubricants during dismantling.
- Separate materials part of the pump, example:
  - ✓ Metal
  - ✓ Plastic
  - ✓ Eletronic scrap
  - ✓ Masses and lubricants

4. Description of the product and accessories

4.1 Technical specification

Fields of application:
Used in the chemical and petrochemical industry as well as in refineries for handling chemically aggressive media with low solids content.
As well used in industry in general as for process pump process gas and condensate.

4.2 Designation



For materials refer to the data sheet.

4.3 Design details

Vertical, radially split shaft-driven sump pump with multiple stages, in wet installation.

4.3.1 Pump casing

Radially split, multiple stages.


For handling combustible media, the pump casing, the pipe assembly and the flanged elbow must be made of ductile material with a maximum magnesium content of 7.5% (see EN 13463-1). This is a standard feature in all KSB supplies.

4.3.2 Impeller

Closed radial impeller with multiply curved vanes. Axial thrust is balanced by means of suction and discharge-side casing wear rings and balancing holes.

4.3.3 Shaft seal

Shaft sealing is effected by gland packing or single or double acting mechanical seals.
The relevant seal version is shown in the mechanical seal drawing.

Arragement drawing (examples)

Gland packing (special variant-consult KSB to use in explosive atmospheres)

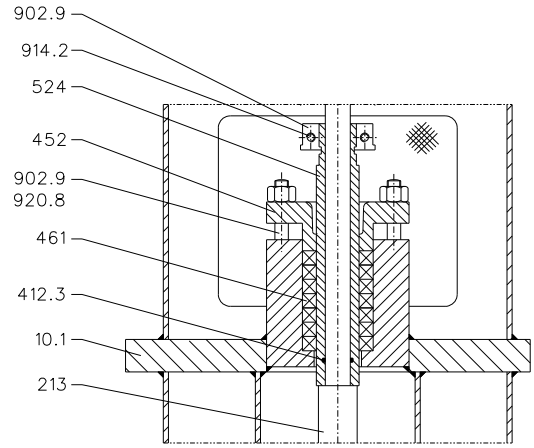
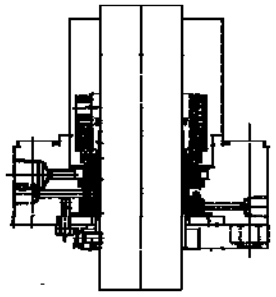
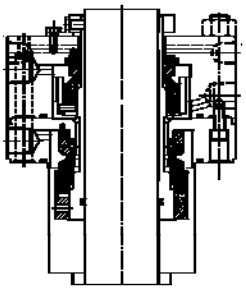


Fig. 02

Mechanical seal



Mechanical seal
Single-acting
Fig. 03



Mechanical seal
Double-acting
Fig. 04

4.3.4 Bearing arrangement

4.3.4.1 Pump bearings

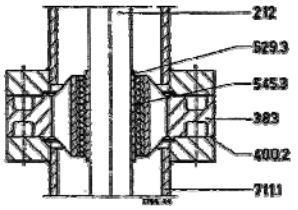
The pump shaft runs in two plain bearings.

The bearing at the suction end is arranged in the suction casing (106) and the bearing at the discharge end is arranged in the discharge casing (107). Both these bearings are lubricated by the product pumped.

4.3.4.2 Intermediate shaft bearings

(See fig. 05)

The intermediate shafts are guided by bearing spiders (383) with built-in bearing bushes (545.3) between the lengths of column pipe. Their construction and lubrication corresponds to that of the pump bearings.

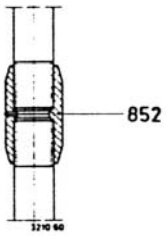


212 Intermediate shaft
383 Bearing spider
400.2 Flat gasket
529.3 Bearing sleeve
545.3 Bearing bush
711.1 Riser pipe

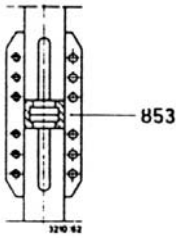
Fig. 05 Intermediate shaft bearing

4.3.4.2.1 Rigid Couplings for intermediate shafts

Depending on the shaft diameter, rotational speed, switching frequency and type of driver, either rigid screwed couplings, or split (muff) couplings are used to connect the intermediate shafts to one another and to transmit the driving torque.
In order to prevent the unscrewing (slackening) of screwed couplings during reverse rotation pumping sets fitted with such couplings must be provided with a reverse rotation stop device.
Hollow shaft motors and hollow shaft bevel gears are equipped with such a reverse rotation stop device. Electric motors of V1 type series are however not so equipped, and the direction of rotation of such motors should therefore be checked before connection to the shafting. It is therefore preferable to use split (muff) couplings in conjunction with V1 type series electric motors. The type of coupling applying to your installation can be ascertained from the data sheet attached to the Order confirmation.
See figures below for construction and arrangement.



Screwed coupling



Split (muff) coupling

4.3.4.3 Thrust bearing

(See fig. 07 and 08 for construction).

The thrust bearing arranged in the motor lantern absorbs the weight of the complete pump rotor, including the weight of the intermediate shafts (212) and drive shaft (213), and the radial forces which arise, it also absorbs the residual axial thrust generated, and transmits all these weights and forces to the motor lantern. Depending on the values 3 different configurations are available. See fig. 06. The bearing is oil lubricated, in the normal execution.
Oil mist lubrication is possible, however it is special and made up on consult.

		Pump sizes			
		40	50 and 65	80 and 100	125 and 150
Thrust bearing constructions	VÖR	6311	6312	6315	6317
	VÖQJ	311	312	315	317
	VÖB	25 (7311)	35 (7312)	45 (7315)	60 (7318)

Fig. 06

VÖB and VOQJ

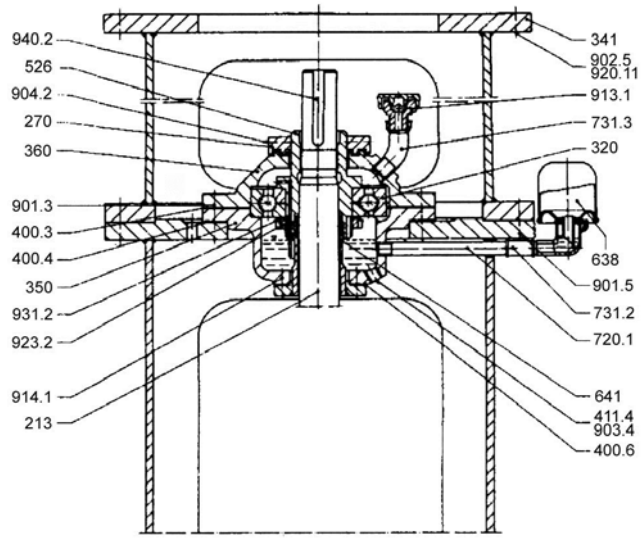


Fig. 07 Construction of support bearing VÖB (deep groove ball bearing and VÖQJ (four point contact bearing).

VÖB

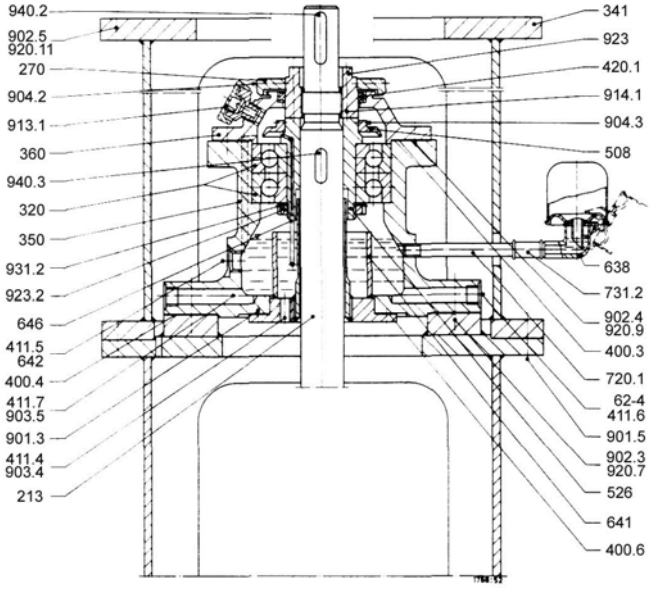


Fig. 08 Construction of support bearing VÖB

4.3.5 Permissible forces and moments at the nozzles

For max. permissible forces & moments refer table below.

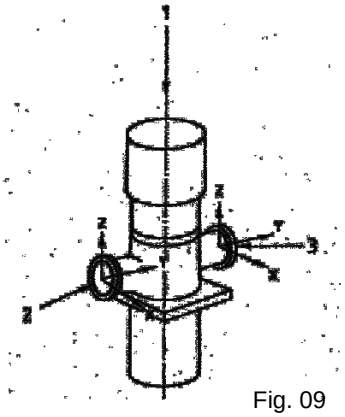


Fig. 09

Pump size			40	50/65	80/100	125	150
Suction	Fx	N	1500	1800	2500	3000	3500
	Fy	N	1500	1800	2500	3000	3500
	Fz	N	1500	1800	2500	3000	3500
	Mx	N.m	1200	1500	2000	2500	3000
	My	N.m	1200	1500	2000	2500	3000
	Mz	N.m	1200	1500	2000	2500	3000
Discharge	Fx	N	800	1500	2000	2500	3000
	Fy	N	800	1500	2000	2500	3000
	Fz	N	800	1500	2000	2500	3000
	Mx	N.m	500	1200	1500	2000	2500
	My	N.m	500	1200	1500	2000	2500
	Mz	N.m	500	1200	1500	2000	2500

4.3.6 Noise characteristics

Rated power input P_N (kW)	Sound pressure level L_{pA} (db) ① ②		
	Pump only		
	2900 1/min	1450 1/min	980 1/min
2,2	60,0	60,0	-
5,5	65,5	65,0	64,5
11,0	70,0	68,5	67,5
15,0	71,5	70,0	69,0
22,0	73,5	72,0	71,0
30,0	74,5	73,0	72,0
37,0	75,5	74,0	73,0
45,0	76,0	74,5	73,0
55,0	76,5	75,0	73,5
75,0	77,5	76,0	74,5
90,0	78,0	76,5	75,0
110,0	79,0	77,0	76,0
132,0	79,5	77,5	76,5
160,0	80,0	78,0	77,0
200,0	81,0	79,0	77,5
250,0	81,5	79,5	78,5
400,0	83,0	81,0	80,0
500,0	84,0	82,0	80,5
750,0	85,0	83,0	81,5
1000,0	86,0	84,0	82,5

① Measured at a distance of 1m 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

As a general rule, the following items are supplied with the pump:

- Motor lantern,
- Special tools and tackles for assembly / disassembly of conical coupling,

On request the following items can be supplied amongst others:

- Coupling: flexible coupling with spacer,
- Coupling guard,
- Coupling extractor device,
- Motor,
- Base plate: welded construction,
- Pressure gauges for suction and discharge,
- ARC valve,
- Suction strainer.

4.5 Dimensions and weights

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

5. Installation at site

Pumps should be installed, leveled and aligned by qualified people. When this service is inappropriate executed, it can have as consequence, operation troubles, premature wear and irreparable damage.

Foundation Plan drawing (FU) informs pump dimension, weights, foundation arrangement, connection sizes and position of fixation elements.

Assure that all parameters for handling and operation (access, assembly area, connections for assembly equipment, cranes, etc) were perfectly established before pump installation activities.

5.1 Safety regulations

Equipment operated in hazardous locations must comply with the relevant explosion protection regulations. This is indicated on the pump name plate and motor name plate (see 2.9).

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 / general arrangement plan.
In case of concrete foundations they shall have sufficient strength (min.class X0) to ensure safe and functional installation in accordance with DIN 1045-2 or equivalent standards.
Make sure that the concrete foundation has set firmly before placing the unit on it. Its surface shall be truly horizontal and even. The foundation bolts shall be inserted in the soleplate.

5.2.1 Place of installation

The distributor casing, the pipe assembly and certain areas of the soleplate take on roughly the same temperatures as the medium handled. The motor stool or bearing bracket lantern must not be insulated.
Take the necessary precautions to avoid burns.

5.3 Foundation

A special base frame must be fitted flush on shims in the foundation or cover aperture to receive the pump set. The concrete base must have set before the base frame is fitted.

Carefully level the machined seating face for the barrel flange using a precision spirit level; use stainless steel shims to compensate for any differences in height.
Do not grout and concrete in the base frame until the pump set has been installed and the levels rechecked.

5.4 Barrel cleaning

Before mounting of barrel in the pit clean carefully inner side of the barrel, keeping it horizontally and tilting it as and when required till it is absolutely cleaned up.

5.5 Mounting

Fit the barrel separately in the leveled base frame, carefully align and secure on the base frame.

Fit and align pump set and driver as described in section 5.6.
Then concrete in the base frame; re-check the alignment and secure the barrel flange to the base frame using studs and nuts.

5.6 Aligning the pump / drive

The pump unit consisting of pump, coupling and drive has been mounted on a common set and is carefully aligned in the manufacturing works.
The following instructions also apply to units not mounted on a common set.

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

Caution Incorrect alignment and inadmissible coupling displacement will affect the operating behavior 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 figs. 10 and 11).

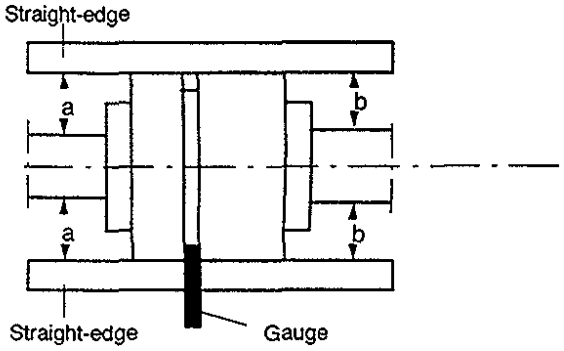


Fig. 10 - Aligning the coupling with the help of a gauge and a straight-edge

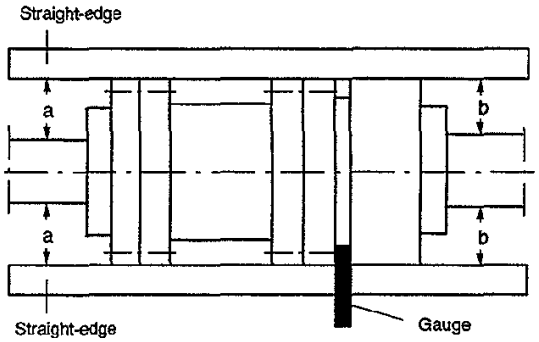


Fig. 11 - Aligning a spacer-type coupling

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 coupling spacer 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 6.1.7). The direction of rotation must correspond to the direction indicated by the arrow on the pump. Verify by switching the motor on and then off again immediately. Fig. 12 ilustrates examples of possible dial micrometer arrangements.

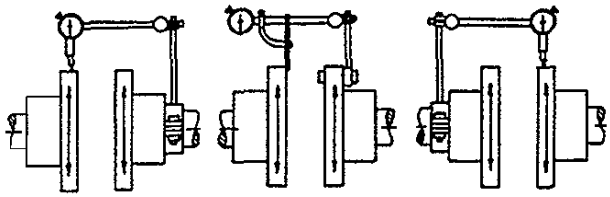


Fig. 12 - Aligning a spacer-type coupling with a dial micrometer

Admissible run-out of coupling face (axial) max. 0,1 mm. Admissible radial deviation, measured over the complete circumference, max. 0,2 mm.

5.7 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).
The pipelines shall be anchored in close proximity to the pump and 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.
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 fluid handled can escape into the atmosphere.
Danger of life when toxic or hot fluids are handled!
The flange covers on the pump suction and discharge nozzles must be removed prior to installation in the piping.

Caution After the piping has been connected, it must be easy to rotate the pump shaft by hand at the coupling.

Recommendations for suction

In the pump installation, please consider the following conditions:

a) Check minimum distance from bottom well up to suction outlet or strainer according to installation (see foundation plan).

b) Check liquid minimum level above pump casing, in order to avoid dry operation, cavitation or vortex.

c) In case of frequent liquid level variation, it should foreseen the installation of protection system against operation below the minimum level.

d) In case of liquid with solids in suspension or with excessive dirty, it should foreseen strainer in the pump inlet.

Recommendations for discharge piping

The discharge piping assembly should comply with the following considerations:

a) It should have disposals for water hammer control, every time the overpressure values, deriving from liquid return in long pipings, exceeds the recommended values for piping and pump.

b) In the points where it is necessary to extract the air it should foreseen vent valves.

c) It is necessary to foreseen tie bolted assembly joints, to absorb system reaction efforts, deriving from applicable loads.

d) Safety valves, relief disposals and other operation valves, besides those mentioned, should foreseen when necessary.

5.7.1 Auxiliary connections

The dimensions and locations of the auxiliary connections (cooling, barrier liquid, flushing liquid, etc.) are indicated on the general arrangement drawing or piping layout.

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

5.7.2 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 contact guard in our delivery, then the operator must supply one. In this case, it is important to make sure that the materials selected for coupling and coupling guard are non-sparking in the event of mechanical contact. KSB's scope of supply meets this requirement.

5.8 Final check

Re-check the alignment as described in section 5.6 and verify the correct distance between the coupling and the coupling guard.
It must be easy to rotate the shaft by hand at the coupling.

5.9 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).
In hazardous areas, compliance with IEC60079-14 is an additional requirement for electrical connection.

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 Preparations

6.1.1 Recommended safety instrumentation for pump

a) Level switch for low level in suction tank.

b) Differential pressure indicator with switch across the suction strainer.

Both these instruments should give trip signal for motor.

6.1.2 Lubrication

Check the bearing lubrication and correctly fill with the specified amount of lubricant. See 6.1.4 for lubricant fill and quality.

6.1.3 Pre-commissioning checks

a) Flushing of suction tank, suction pipeline with water after chemical cleaning. Take care to blind the pump suction and discharge nozzles before flushing;

b) Cleaning of suction strainer;

c) Barrel cleaning; see 5.4;

d) Shaft seal;
   I) Check shaft seal and pack as described in 6.1.5.1 (applicable for gland packing execution only);
   II) Remove auxiliary piping for mechanical seal ie. cooling, flushing, quenching, etc. It must be thoroughly cleaned with water, dried and then refitted.

e) Fit suction and discharge pressure gauges;

f) Check functioning of all interlocks by stimulation method;

g) Priming – see 6.1.6 for details;

h) Check free rotation of shaft manually.

6.1.4 Lubrication

Oil lubrication

The support bearing is lubricated by the oil fill in the bearing housing (350). An oil elevator tube (646) inside the centering sleeve (526) supplies oil to the antifriction bearing. The requisite oil level is maintained by a constant level oiler (638). The reservoir of this constant level oiler must therefore always be kept topped up with oil.

Filling and topping up (see fig. 13).

Filling and topping

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

The oil level should always be below the level of the vent opening arranged at the top edge of the connection elbow.

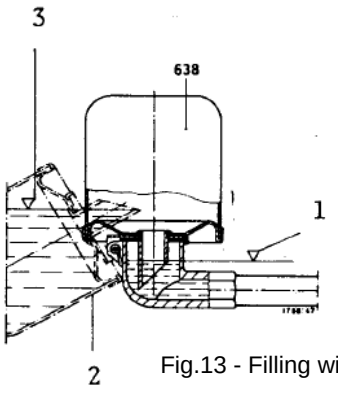


Fig.13 - Filling with oil

1. Oil level in bearing housing and in connection elbow.
2. Position for topping up of oil level make-up quantity.
3. Oil level in oil reservoir after filling of same.

Oil changes and oil requirements

The first oil change should take place after the first 300 hours of operation, and subsequent oil changes should be effected after every 3000 hours of operation, but at least once a year.

Unscrew and remove the drain plug (903.4) on the bearing housing and drain the oil. After draining of the bearing housing, replace the drain plug and fill in fresh oil.

Pump sizes	40	50 65	80 100	125 150
Oil fill [1)] ltrs	0,3	0,5	0,6	1,2

1) Oil filling quantity (including constant level oiler and filler pipe).

Fig. 14 Oil requirements

Oil specification

The oil used should exhibit the following characteristics:

Kinematics viscosity at 50ºC = 30 to 45 mm^2/s
Density at 20ºC = 0,9 kg/dm^3
Flash point = at least 150ºC
Pour point = below -5ºC
Ash content = not exceeding 0,05%
Neutralization number = not exceeding 0,3
Asphaltenes = 0%

Lubrication by product pumped

The pump bearings and intermediate shaft bearings are lubricated directly by the product pumped (suction side bearing by inlet pressure and intermediate shaft bearings by liquid at pump discharge pressure). No special maintenance of these bearings is necessary, but the pump must not be allowed to run dry.

6.1.5 Shaft seal

6.1.5.1 Gland packing

Caution Gland packings supplied with the pump have to be installed prior to pump startup (unless they were fitted prior delivery).
The gland packing must be tightened gently and evenly.
It must be easy to rotate the shaft by hand.

a) Fitting new packing

Thoroughly clean the packing compartment and the shaft protection sleeve, and coat them with molybdenum disulphide. Insert neck ring (457), if any, and press it home until it abuts. Insert the packing rings individually and push them home with the aid of the stuffing box gland and the seal cage ring. The ring butt of each packing ring should be offset 90º in relation to the joints of the adjoining rigid. In case of lubrication by an external source insert seal cage ring (458) so that it registers opposite connection 10E.

Then insert the remaining packing rings individually. Leave a sufficient clearance gap at the entrance of the stuffing box for the positive guidance of the gland. The inserted packing rings should only be lightly compressed by the gland and the nuts.

Then the nuts should be slackened and tightened again by hand. The even seating of the gland should be checked with a feeler gauge, with the pump subjected to suction pressure.

b) Removing the packing

Slacken clamping ring (184) and remove it from shaft protection sleeve (524), undo stuffing box gland (452) and pull it out of stuffing box housing.

Pull the top packing rings out of stuffing box housing (451) with the aid of a packing ring extractor, pull out seal cage ring (458), if any, then remove the remaining packing rings and examine shaft protection sleeve (524) for signs of damage.

Clean the packing compartment and coat it with molybdenum disulphide.

Pack the stuffing box as described under a) above.

N.B.

The stuffing box should drip slightly whilst the pump is running the leakage rate should amount to between 2 and 3 l/h. If your pump has sealing and cooling liquid connections in use, they should be checked for unimpeded flow. When the stuffing box gland has been repeatedly tightened in service until it abuts, it is time to renew the packing in the stuffing box.

Packing material

When selecting the packing material, remember to ascertain its compatibility with the product pumped. Always use new packing material, preferably material which has been stored for a certain period, to repack the stuffing box.

Pump sizes	Packing compartment dws / da mm	Number of packing rings	Width of packing mm	Overall length mm
40	40 / 60	6	10	1400
50	45 / 70	6	12,5	1500
65	45 / 70	6	12,5	1500
80	55 / 80	6	12,5	1600
100	55 / 80	6	12,5	1600
125	80 / 112	5	16	1800
150	80 / 112	5	16	1800

dws = Outer diameter of shaft protection sleeve
da = Inner diameter of packing compartment

Fig. 15 Dimension of packing compartment and packing.

6.1.5.2 Mechanical seal

Caution The mechanical seal has been fitted prior to delivery. On variants with quench supply tank, the tank must be fitted in accordance with the general arrangement drawing (see also 6.1.6). Quench feed must also be provided during pump shutdown. On variants with pressurized dual mechanical seals, apply barrier pressure as specified in the general arrangement drawing prior to starting up the pump (see 6.1.6). Barrier pressure must also be provided during pump shutdown.

Caution For external liquid supply, the quantities and pressure specified in the data sheet and general arrangement drawing shall be applied.

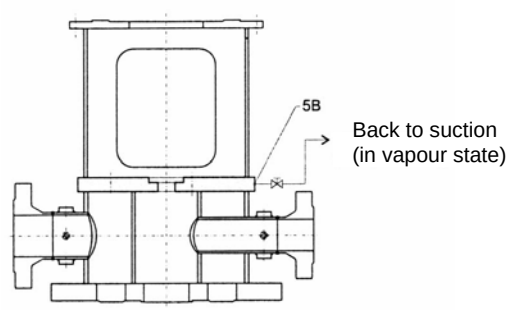
6.1.6 Priming the pump and checks to be carried out

The barrel must be filled at all times with product.

The pump body must be vented through the discharge pipe during priming before commissioning.

6.1.6.1 Vacuum balance line

If the pump has to pump liquid out of a vessel under vacuum it is advisable to install a vacuum balance line. The suction area (barrel and distributor casing) is vented via a line which remains open all the time. This line should have a nominal size of 25 mm minimum. It should be arranged to lead back into the vacuum vessel in vapour phase.



Caution **Never run the pump dry!**

Open or switch on all auxiliary lines (cooling, lubrication, sealing liquid etc) and ensure they are not blocked.

For water cooling, use suitable non-aggressive cooling water not liable to form deposits and not containing suspended solids. (Hardness: on average 5dH; (~1 mmol/l); pH > 8, or conditioned and neutral with regard to mechanical corrosion).
Inlet temperature t_E = 10 to 30ºC
Outlet temperature t_A max. 45ºC

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

6.1.6.2 Cooling

Caution In general, the shaft seal must be cooled if the vaporization pressure of the fluid handled is higher than the atmospheric pressure.
Depending on the fluid handled, the system pressure and the mechanical seal material, the limit may change (example: hot water).

Caution Observe permissible temperature classes.

6.1.7 Checking the direction of rotation

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

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

Correct direction of rotation:
The direction of rotation must correspond to the direction indicated by the arrow on the pump.
Never put your hands or any other objects into the pump.

Caution The motor's direction of rotation must be checked with the pump/motor coupling removed.
If the motor runs in the wrong direction of rotation, interchange two of the three phases in the control cabinet or motor terminal box.
The safety instructions set forth in section 2.9.3 must be complied with.

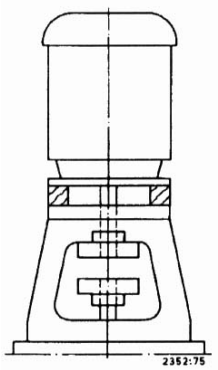


Fig. 16 – Decoupled drive

6.2 Start-up

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

Caution Pump operation with the shut-off valves in the discharge and suction pipes closed is not permitted.
The permissible pressure and temperature limits might be exceeded. In extreme cases, the pump may burst.

Caution After the operating temperature has been reached and / or in the event of leakage, switch off the unit and re-tighten the applicable bolts. Permissible tightening torques see 7.5.3.

Caution Check the coupling alignment at operating temperature as described in section 5.6 and re-align, if necessary.

Immediate steps after start up

After start up and with pump in process, please observe the following items:

a) Control electric power consumption (amperage) and voltage;

b) Certify that the pump runs free of vibration and abnormal noises;

c) Control support bearing temperature, which can reach up to 40ºC above ambient temperature; however the sum of them cannot exceed 82ºC.

The above items should be controlled each 15 minutes during the first 2 hours operation. If everything is normal, new controls should be made each 1 hour, during the first 5 up to 8 hours. If there is anything abnormal during this period, please consult chapter Functioning Abnormalities and its eventual Causes.

6.2.1 Minimum flow

(For the protection of the pump when operating at low loads).

General

The power absorbed by the pump does not decrease proportionately with decreasing rate of flow, but on the contrary still amounts to more than 50% of the power absorbed at the design duty point at zero flow (pump shut off point). In order to carry off this energy which is converted into heat inside the pump, it is necessary to maintain a minimum rate of low through the pump.

In the case of pumps with discharge nozzles of nominal sizes between 40 and 150 this minimum rate of flow normally amounts to 0,15 Qopt, taking the heat conditions and the pattern of the characteristic curve into account. In the case of pumps with larger sizes of discharge nozzle, this minimum rate of flow amounts to 0,2 Qopt. Qopt = Rate of flow at maximum efficiency of the pump.

Caution The pump should only be operated at rates of flow below the minimum rate of flow during the switching on and switching off process. Excessive wear and damage to the pump cannot be excluded under these circumstances.

Minimum flow circulation via a permanent bypass

The permanent bypass recirculation is selected for plants with relatively low pressures and low minimum flow rates. This system is very attractive from the point of view of low first cost, but is uneconomic in operation because the minimum flow (or bypass flow) has to be circulated over the entire operating range of the pump. When sizing the pump, the bypass rate of flow must be added to the pump capacity.

In order to ensure the minimum flow, an orifice plate is fitted in the bypass line between the pump and the suction vessel.

Minimum flow circulation via an automatic recirculation valve

The automatic recirculation valve ensures the minimum flow protection requirement simply and reliably. It is mounted vertically in the discharge line between the pump discharge nozzle and the isolating valve, in such a way that the fluid flow through it from bottom to top.

As soon as the rate of flow of the pump falls below a given minimum value, the bypass outlet on the automatic recirculation valve opens sufficiently wide for a predetermined minimum flow quantity to pass through and be maintained even when the rate of flow through the main discharge line is reduced to zero.

6.3 Shutdown

Close the shut-off valve in the discharge line.
If the discharge line is equipped with a non-return or check valve, the shut-off valve may remain open. If shut-off is not possible, the pump will run in reverse direction.

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 down smoothly to a standstill.
Close the auxiliary lines but do not turn off the cooling liquid supply, if any, until the pump has cooled down.
Please refer to section 6.1.5.2.
In the event of frost and / or prolonged shutdowns, the pump – and the cooling chambers, if any – must be drained or otherwise protected against freezing.

6.4 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!

6.4.1 Temperature of the fluid 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 see 7.2.1.

The safety instructions set forth in section 2.9 must be complied with.

6.4.2 Switching frequency

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

Motor rating (kW)	max. S (start –ups / h)
up to 12	15
up to 100	10
more than 100	5

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

6.4.3 Density or fluid pumped

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

6.4.4 Abrasive fluids

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 shall be shortened.

6.4.5 Minimum / Maximum flow

Recommended operation flow range is Q = 0,5 up to 1,15 $Q_{opt.}$
Q_{opt} = optimum efficiency
For minimum flow in short periods of operation see 6.2.1.
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 build-up may lead to a

dangerous temperature increase at the pump surface. If necessary, the minimum flow must be increased.

$$T_o = T_f + \Delta\vartheta$$

$$\Delta\vartheta = g * H / c * \eta * (1 - \eta)$$

c	Specific heat	[J / kg K]
g	Acceleration due to gravity	[m / s^2]
H	Pump head	[m]
T_f	Temperature of fluid handled	[ºC]
T_o	Temperature of casing surface	[ºC]
η	Pump efficiency at duty point	[-]
$\Delta\vartheta$	Temperature difference	[ºC]

6.5 Shutdown / storage / preservation

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

6.5.1 Storage of new pumps

- New pumps are supplied by our factory duly prepared for storage. Maximum protection for up to 6 months, if the pump is properly stored indoors.
- Store the pump in a dry location.
- Rotate the shaft by hand once a month.

6.5.2 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 pump nozzles (e.g. with plastic caps or similar).

6.6 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 " Preparations " (6.1) and "Operating Limits "(6.4) must be observed.

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

7. Servicing / maintenance

7.1 General Instructions

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.
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 to life!).

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

7.2 Servicing / 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.
Always ensure a sufficient liquid level above the pump inlet.

Prolonged operation against a closed shut-off valve is not permitted. When operating the pump set with the shut-off valve in the discharge line slightly open for a short period of time, the permissible pressure and temperature limits must not be exceeded.

A special design is required to comply with temperature class T6 in the bearing area. In such cases, and if ambient temperature exceeds 40ºC, contact the manufacturer.
Verify correct oil level as described in section 6.1.4.
The shut-off elements and the auxiliary feed lines must not be closed during operation.
Any stand-by pumps installed shall be started up regularly, e.g. once a week, to keep them operational. Attention shall be paid to the correct functioning of the auxiliary connections. 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 5.6.

Supervision during operation

Depending on the labor availability and pump responsibility, we recommend the following checks, and in case of any abnormality the maintenance responsible should be advised immediately.

Weekly supervision
Check:

a) Pump operation point;

b) Motor current consumption and net tension value;

c) Vibration and abnormal noises;

d) Bearing housing temperature;

e) If applicable, the gland packing should drip slightly whilst the pump is running. The gland should only be tightened lightly.

Monthly supervision
Check:

a) Oil change interval, (if applicable).

Semestral supervision
Check:

a) Base frame and motor fix bolts;

b) Pump-motor set alignment;

c) Coupling lubrication (when applicable).

Annual supervision
Disassemble the pump for maintenance. After cleaning, inspect bearings, (do it in detail), retainers and / or bearing sealings, joints, O´rings, impellers, casing internal regions (control also thickness), wear areas and coupling.

Note:
In installations with good operation conditions and pumped liquid not aggressive to the pump materials, the supervision can be done each 2 years.

7.2.2 Lubrication and lubricant change

See section 6.1.4.

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 fluid. All relevant laws must be heeded. If required, wear safety clothing and a protective mask!
If the fluids 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.
The flushing fluid used and any liquid residues in the pump must be properly collected and disposed of without posing any risk to persons or the environment. See also section Discard (3.3.2).

7.4 Dismantling


Before dismantling the pump, secure it so as to make sure it cannot be switched on accidentally.
The shut-off valve in the discharge line must be closed.

The pump set must have cooled down to ambient temperature, pump pressure must have been released and the pump must have been drained including oil of bearing housing, if any.

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 assembly drawing. The general assembly drawing and other relevant documents are found in the annex. The dismantling sequence can be derived from the general assembly drawing.
In case of damage you can always contact our service departments.

7.4.2 Dismantling the pump

7.4.2.1 Dismantling the thrust bearing

1. Pull the pump end half coupling off drive shaft (213) with the aid of puller. Remove key (940.4).

2. Unscrew and remove oil labyrinth (270);

3. Unscrew bearing cover (360), and remove centering sleeve (526) together with antifriction bearing (320) and bearing cover (360) from the shaft by twisting the centering sleeve. Pull the bearing cover (360) off the centering sleeve (526).

4. Dismantle constant level oiler (638) together with its connecting pipe.

5. Unscrew bearing housing (350) force it off and pull if off over shaft (213) together with oil stand pipe (641).

6. Unlock and unscrew withdrawal nut (923.2), push antifriction bearing (320) off the centering sleeve, clean it with wash oil and examine it.

7.4.2.2 Dismantling the shaft seal

Gland packing

1. Unscrew screws (914.31) in clamping ring (184).

2. Pull the shaft protection sleeve together with the clamping ring off the shaft.

3. Unscrew hex nuts (920.31) and remove stuffing box gland (452).

4. Remove packing rings (461) and seal cage ring (458) from the stuffing box housing, if any.

Mechanical seal

See specific instructions.

7.4.2.3 Dismantling the pump body

Caution After a prolonged period of operation, it may happen that individual rotor components (impeller and distance bushes) are difficult to pull off the shaft, in such cases, do not use force or hammer blows. First try using a suitable rust solvent or a puller device. If these measures do not lead to the desired result, the components concerned can be warmed up slightly and then pulled off or forced off. The shaft should remain as cold as possible during the warming up process. If rotor components are dismantled by warming up, the shaft should subsequently be checked for radial run out.

1. Unscrew studs and nuts (902.1 and 920.5) between distributor casing (10-1) and column pipe main, force off pump body together with column pipe, and dismantle distributor casing. Carefully underpin the drive shaft (213).

2. Dismantle the column pipe.

3. Unscrew the intermediate shaft coupling or disassemble the muff coupling and remove drive shaft (213).

4. Unscrew nuts (920.1) of tie rods (905) at suction end, remove them and pull out the tie rods.

5. Force off suction casing (106).

6. Undo nut (920.2) and remove it together with the lock washer (931.1).

7. Pull suction impeller (231) off pump shaft (211), and remove key.
   Underpin the stage casing.

8. Force off and remove stage casing (108) including first stage diffuser (171.1) and suction side bearing. Do not damage the sealing faces.

9. Pull the stage sleeve (521.1) from the shaft and remove the split ring (501.2).

10. Pull the impeller (230) off the pump shaft (211) and remove key. Support the stage casing.

11. Press off and remove the stage casing (108) and diffuser (171.2).

12. Press the stage sleeve (521) from the shaft.

13. Dismantle all the remaining stages in the same way as described in points 10 to 12 above.
    In the case of multistage pumps, mark the impellers and stage casings in their correct sequence, to facilitate reassembly.

14. Pull discharge casing (107) off the shaft and store the shaft with due care.

7.4.2.4 Dismantling of pumps installed very deep down

1. Carry out preparations as described in section 7.4.1.

2. Dismantle thrust bearing as described in section 7.4.2.1

3. Dismantle shaft seal as described in section 7.4.2.2.

4. Pull the pumping set far enough out of the barrel by means of the distributor casing (10-1) to enable a pipe clip to be attached some 50 cm beneath the next column pipe joint.

   Firmly fasten the pipe clip and lower the pumping set again until the pipe clip rests on top of the barrel. Unscrew the pipe joint connecting the lengths of column pipe main, and lift the distributor casing and the upper length of column pipe main (711.1) over the drive shaft. Unscrew the intermediate shaft coupling or disassemble the muff coupling and remove drive shaft (213). Force off the complete intermediate shaft bearing and pull it off over the shaft.

   Examine the bearing and shaft for signs of galling (seizure). If necessary, raise the pumping set by a further length of column pipe main, again fit a pipe clip and lower the pumping set until the pipe clip rests on the barrel. Then dismantle the length of column pipe main and the bearing. Lift the pump body out of the barrel, then set it down and underpin it in the horizontal position for dismantling.

5. Dismantle the pump body in accordance with section 7.4.2.3, points 4 to 14.

7.4.3 Examination of individual components

7.4.3.1 Shafts (211, 212, 213)

Inspect the bearing sleeves (529) on the shafts for signs of galling (seizure). Slight traces of damage can be removed by grinding within the permissible clearance limits. If the touching up works should result in the permissible clearances being exceeded, then new bearing sleeves (529) must be placed on.

Carry out an out-of-round check on a lathe between dead centres. The max. permissible shaft whip must not exceed 0,03 mm.

Caution Make sure the shaft is accurately centered on the lathe, as otherwise the readings will be erroneous.

If certain rotor components are replaced by new ones, or have been touched up, or if a new shaft has been fitted, the pump rotor must be balanced dynamically, preferably at the max, operating speed of the pump, but at least at 1000 1/min. The max. permissible residual eccentricity is 5 microns.

7.4.3.2 Bearing arrangement

Antifriction bearings (320)

Even if they only exhibit slight discoloration marks or specks of rust, or signs of damage to the running surfaces, the bearings must be replaced by new ones.

Observe the greatest cleanliness when mounting the bearings. Use washing oil to clean the old bearings. After washing, the bearings should be dried and immediately sprayed with oil.

Plain bearings (pump and intermediate shafts)

Examine the bearing bushes for signs of galling (seizure). If necessary, fit new bearing bushes (see table, fig. 20).

7.4.3.3 Shaft seal

Soft packed stuffing box

Use new packing material every time the pump is overhauled. The shaft protection sleeve (524) may only be touched up very lightly by grinding.

If it exhibits signs of damage, a new shaft protection sleeve should be fitted.
(For pump with impeller rings and inter stage bushes, see supplementary sheet).

7.4.3.4 Pump body

Suction casing (106), discharge casing (107), stage casings (108), impellers (230, 231), casing wearing rings (502), bearing bushes (545), stage sleeves (521).

Ensure all the sealing faces are in perfect condition. Check the plane parallelism of the faces at 4 points on the circumference with a micrometer. The deviation must not exceed 0,02 mm. Damaged faces can be machined on a lathe. The surface roughness must not exceed 0.8 µm (micron meter).

The stage casings (108) and diffusers (171) are fitted with renewable casing wearing rings (502).

Check the impellers and wearing rings for galling and check the rotor clearances per fig. 19.

The casing wearing rings must be machined when fitted and the max. permissible clearances must be respected. Any increase in clearance must be made uniform at all wearing points inside the pump.

If the bearing clearances are the same as or greater than the max. permissible clearances per Fig. 20. Fit new oversized wearing parts and re-establish the “as new” clearances.

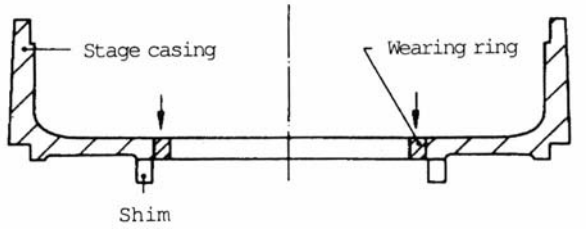
Fitting new casing wearing rings (502)

1. Undo the allen grub screw, press the casing wearing rings in the stage casing and diffuser out of the fit taking care not to damage the fit. (see fig. 17).

2. Uniformly press new wearing rings.

3. Smooth down all impellers (230, 231) in the region of the suction and discharge throttle section to a common diameter, basing this on the most heavily scored section.

Single deep grooves can be left untouched. See figs. 18 & 18a.



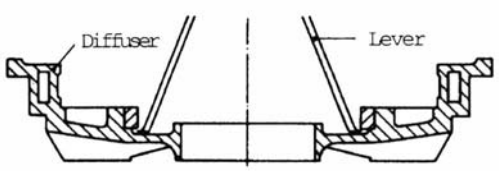


Fig. 17 Renewing the casing wearing rings.

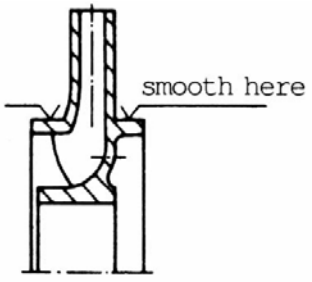


Fig. 18 Smoothing out the throttling sections on the impellers, see fig. 18a.

Pump sizes	Smallest impeller neck ∅		Max. ∅ Diffuser bore [1]
	1st stage impeller without wearing ring	Stage impellers without wearing ring	
40	88,2	78,2	46,5
50	103,2	88,2	49,5
65	113,2	98,2	49,5
80	128,2/118,2[2]	113,2/118,2[2]	53,5/51,5[2]
100	143,2/148,2[2]	128,2/148,2[2]	53,5/61,5[2]
125	178,2/168,2[2]/188,2[3]	148,2/168,2[2]	66,5/67,5[2]
150	213,2/198,2[2]	198,2[2]	81,5/79,5[2]

Fig. 18a Smallest permissible impeller neck dia and max. diffuser bore dia.

[1] not for 1st stage (for single wearing ring execution)
[2] hydraulic WKL
[3] special hydraulic

If these limiting values are exceeded replace with new spares.

7.4.3.5 Metaflex coupling

Check the flexible transmission elements for wear and replace if necessary.

7.4.3.6 Rotor and bearing clearances

Pump sizes	Operating temperature °C	Clearances mm on ∅ for material combination			
		0,4 "as new"	1,0 max. perm.	0,6 "as new"	1,2 max. perm.
40 to 150	0 to +200	Cast iron / Cast iron		AISI 316 / AISI 316	
		12% Cr / 12% Cr			

Fig. 19 Impeller / Casing wearing ring clearance.

Pump sizes	Operating temperature °C	Clearances mm on ∅ for material combination			
		0,4 "as new"	1,0 Max. perm.	0,6 "as new"	1,2 Max. perm.
40 to 150	0 to +105	Cast iron / Cast iron Carbon Steel		AISI 316 / A743CF8M 12% Cr / 12% Cr	
40 to 150	+106 to +200	-		Cast iron / Cast iron 12% Cr / 12% Cr or Carbon Steel	

Fig. 19a Stage sleeve / diffuser clearance.

Pump size	Bearing 1st stage diffuser		Bearing in discharge casing		Intermediate shaft bearing	
	Min.	Max.	Min.	Max.	Min.	Max.
40	0,040	0,106	0,050	0,128	0,050	0,128
50						
65						
80						
100			0,060	0,152		
125	0,050	0,128			0,060	0,152
150						

Fig. 20 Plain bearing clearance (in mm referred to Ø).

7.4.3.7 Dynamic balancing of pump rotor

For this purpose, the pump rotor should be assembled as follow:

Assembly proceeds from the front end; slip stage sleeve (521) onto pump shaft (211) until it abuts against the shaft shoulder. Insert the key and slip final stage impeller (230) onto the shaft until it abuts.

Mount the stage sleeve (521) (sleeve (520), on pump size 150), - keys and impellers (230) of the remaining stages in sequence, as described above. Fit the split ring (501) and key (940.2). Push on the stage sleeve (529.1) and suction impeller (231).

N.B. The impellers must be mounted in their correct stage sequence.

Slip on lock washer (931.1) and clamp the mounted components together on pump shaft (211) with the aid of shaft nut (920.2).

Place the bearing sleeve and fix it with the circlip 932.1.

Before dynamic balancing, the rotor should be checked for true running (out-of-round) at the impellers (230) and at the bearings. The measured out-of-round value must not exceed 0,03mm. The rotor should then be balanced dynamically at max. pump operating speed if possible but at least at 1000 1/min. The max. permissible residual eccentricity must not exceed 5 µm (micron meter). Before final assembly in the pump, the pump rotor must be dismantled again in reverse sequence to the assembly procedure described above.

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. Verify the dimensions given in fig. 18, 19 e and 20. Damaged or worn components are to be replaced by **original spare parts**. Make sure that the seal faces are clean and that the sealing elements are properly fitted.
Always use new sealing 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 materials 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 shall only be applied at selected points (3 to 4 spots) and in thin layers.
Do not use cyanoacrylate adhesives (quick-setting adhesives)! If in certain cases mounting aids or anti-adhesives other than described herein are required, please contact the sealing material manufacturer.

Caution **All graphite gaskets must only be used once!**

Never use O-rings that have been glued together from material sold by the metre.

Caution Do no 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 oils or greases!
The locating surfaces of the individual components must be coated with graphite or similar before reassembly. The same applies to screwed connections.

See section 7.5.2.5.1 for reassembly of pumps installed deep down.

7.5.2 Preparations

Before reassembly of ring section pumps, the stage sleeve "E" of each stage casing (108) and of the associated impeller (230, 231) with stage sleeve (521) must be measured. Any discrepancy in lengths must be compensated by machining the stage sleeve (521) only, and the end result must be E1 = E2. (See fig. 21).

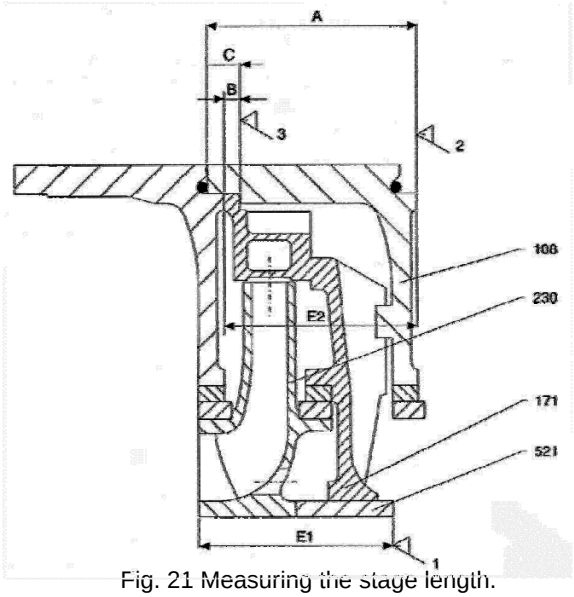


Fig. 21 Measuring the stage length.

If machining of the stage sleeve is required, it should be shortened at both end faces in one operation on the machine tool. The permissible end face whobble (deviation from plane parallelism) is 5 µm (micron meter).

Do not damage the contact faces on the casing components, diffusers, impellers, spacer and stage sleeves before and during assembly. All pump components, particularly the end contact faces, should be thoroughly cleaned. If new impellers are fitted, or if the old ones are touched up, the rotor must be balanced dynamically.

7.5.2.1 Assembly of pump body

1. Put the key (940.3) on the pump shaft (211) and slide the bearing sleeve (529.2) from the end, until it abuts against the shaft shoulder. Place the circlip (932.2).
2. Push discharge casing (107) with fitted bearing bush (545.2) and diffuser (171.2) onto pump shaft (211) from the drive end.
3. Slide stage sleeve (521) – (sleeve (520) in the case of pump size 150) – onto pump shaft (211) from the front end, until if abuts against the shaft shoulder.
4. Inert key and slip final stage impeller (230) onto pump shaft (211).
5. Insert diffuser (171.2) of the following stage into stage casing (108) and mount the stage casing together with O-ring (412) against discharge casing (107).
6. Mount the remaining stages in the sequence: stage casing with diffuser, stage sleeve, impeller (230) – observe the markings. Insert the split ring (501) and key (940.2), press on stage sleeves (521.1), diffuser (171.1) with suction side bearing and suction impeller (231).
7. Put the lock washer (931.1) on the shaft and tighten up the shaft nut (920.2).
8. Put the key (940.1), slide the bearing sleeve (529.1) and fix it with the circlip (932.1).
9. Fit the suction casing (106) with bearing bush (545.1) on the stage casing (108).
10. Clamp the discharge, stage and suction casings together with the aid of the tie rods (905). Use a torque wrench for this purpose.
11. Connect the drive shaft (213) or the intermediate shaft (212) to the pump shaft (211) by means of screw or muff coupling. Underpin the drive shaft / intermediate shaft properly.
12. If applicable, lift the column pipe with gasket (400.1) over the drive shaft / intermediate shaft and mount it on the pump body.
13. Fasten the pump body with column pipe and gasket (400.1) on the distributor casing.

7.5.2.2 Assembly of shaft seal

(See installation drawing for type of shaft seal fitted to your pump.)

7.5.2.2.1 VSM Soft-packed stuffing box (fig. 02)

1. Slip the stuffing box gland (452) over the drive shaft (213).
2. Slip the shaft protection sleeve (524) including the O´ring and the clamping ring (184) over shaft (213).
3. Pack the stuffing box in accordance with section 6.1.5.1.
4. Adjust the shaft protective sleeve (524) with clamping ring (184).

7.5.2.3 Assembly of thrust bearing

Fig. 07 and 08

1. Thoroughly clean centering sleeve (526) and examine the oil retaining tube for unimpeded flow.

2a. Slip the four point contact bearing (320) with one inner race onto the centering sleeve and then slip on the second inner race.

2b. Slip de bearing(s) (320) onto the centering sleeve, in case of deep groove ball or pair of contact angular bearings.

Note: Prior to this, warm up the antifriction bearing to 80ºC approx. in an oil bath.

3. Slip on locking washer (931.2), screw on withdrawal (923.2) nut , tighten it and lock it with the locking washer.

4. Fit bearing housing (350) including oil stand pipe (641) and gasket (400.6/4) on the distributor casing (10-1) and fasten it.

5. Twist centering sleeve (526) together with previously mounted antifriction bearing onto drive shaft (213).

6. Insert gasket (400.3), mount bearing cover (360) and fasten it. The vee notches integrally cast into the bearing housing and bearing cover must register opposite one another on reassembly, and so must the cut-out on the gasket, to enable the oil return flow grooves to fulfill their function properly.

7. Adjust the axial rotor position in accordance with section 7.5.2.4.

8. Mount deflector (270).

9. Fit constant level oiler (638) together with its connecting pipe.

7.5.2.4 Adjustment of axial position of pump rotor

The pump rotor position must be adjusted axially after completion of mounting of the bearings and motor lantern and before the drive coupling is mounted.
The total axial play of the rotor is ascertained by lowering and raising it to its bottom and top abutments by means of the centering sleeve (526) which has a 1,5 mm screw thread pitch. The rotor is subsequently raised to its top abutment, then lowered by an amount equal to 0,4 times the total axial play. Thereafter the centering sleeve (526) is locked in position by means of the gib key.
If the gib key cannot be slotted in because the slot in the centering sleeve does not register immediately opposite, twist the sleeve to right or left until the nearest slot registers with the gib key.

7.5.2.5 Final assembly and installation of pump

1. Mount pump end half coupling on drive shaft (213).

2. Lay internal auxiliary piping in accordance with the installation drawing.

3. Examine barrel for dirt and clean it if necessary.

4. Carefully clean the sealing faces on the barrel and distributor casing and insert the o'ring or gasket. Check the parallelism of the sealing faces between barrel flange and distributor casing flange.

5. Attach ropes to the motor lantern, carefully raise the pump to a vertical position and fit in the barrel. Check the alignment and bolt the distributor casing (10-1) on to the barrel (10-3).

6. Connect the suction line and discharge line, refer to section 5.7.

7. Mount driver and check coupling alignment. (see section 5.6).

8. Fill in oil (see section 6.1.4).

9. Start up the pump in accordance with section 6.2.

7.5.2.5.1 Final assembly of pumps installed very deep down

If the pumping set cannot be inserted in the barrel as a complete unit because of its length, the pump body, column pipe main, distributor casing, shaft seal and bearings should be assembled as follows.

1. Inspect barrel for dirt and clean it if necessary.

N.B. Do not damage the special coating inside barrel and column pipe main.

2. Assemble pump body in accordance with section 7.5.2.3, points 1 to 8.

3. Connect the pump shaft to the intermediate shaft by means of a screwed or muff coupling (see section 4.3.4.2.1). Slip gasket (400.1) and column pipe (711.2) over the shaft and attach them to discharge casing (107). Mount a pipe clip on column pipe 711.2 and fasten it securely.

4. Carefully raise the pump body to a vertical position and lower it into the barrel (10-3) until the pipe clip rests on the top rim of the barrel. Take care not to damage the sealing face of the barrel flange. Then place the intermediate shaft bearing with gaskets in position.

5. Mount the drive shaft (213) or the next length of intermediate shaft (212). Slip the column pipe (711.1) over the shaft and fasten it. Fasten a second pipe clip on the upper length of column pipe (711.1). Lift the pump, undo and remove the lower pipe clip, and lower the pump into the barrel until the upper pipe clip rests on the barrel flange.

6. Lay the gasket (between barrel and distributor casing) on the pipe clip.

7. Place the distributor casing (10-1) over the drive shaft and fit it on the top flange of the column pipe main or on the intermediate shaft bearing and fasten it.

8. Attach hoisting ropes to the distributor casing, raise the pump, detach and remove the pipe clip, carefully clean the sealing faces on the barrel and distributor casing, insert gasket (412.1 or 400.3) and lower the pump until the distributor casing seats in its correct position on the barrel flange.
   On the construction with gasket, check the parallelism of the sealing faces between barrel flange and distributor casing flange.

9. Check the alignment and fasten the distributor casing on the barrel.

10. Mount the shaft seal and the thrust bearing in accordance with sections 7.5.2.2 and 7.5.2.3.

11. Adjust the axial position of the pump rotor in accordance with section 7.5.2.4.

12. Mount the pump end coupling half on drive shaft (213).

13. Connect the suction line and discharge line, refer to section 5.7.

14. Mount the driver and check the coupling alignment (see section 5.6)

15. Fill in oil (see section 6.1.4).

16. Start up the pump in accordance with section 6.2.

7.5.3 Tightening torques of main fixation in N.m

Denomination		Tie bolt / nut	Nut (First stage)	Hex. head bolt / nut (Column fixation)	Stud / nut (Column fixation)	Stud / nut (Muff coupling)	Stud / nut (Disch. head Fixation or barrel)	Stud / nut (Seal gland fixation)
Part Nº		905 / 920.1	920.2	901.1 and 901.2 / 920.5	902.1 / 920.5	902.9 / 920.9	902.5 / 920.3	902.2 / 920.6
Material		Steel A193 Gr. B7/8,8	AISI 316	Carbon Steel 5.6/6	Carbon Steel 5.6/6	AISI 316 / 304 (AISI 420)	Carbon Steel 5.6/6	AISI 316 / 304
Pump size	WKT40	226	370	100	100	1,0	193	28,0
	WKT50	226	465	100	100	1,0	193	28,0
	WKT65	226	465	100	100	1,0	193	28,0
	WKT80	460	650	100	100	1,0	193	28,0
	WKT100	460	650	100	100	1,0	193	28,0
	WKT125	2000	900	193	193	8,3	193	69,0
	WKT150	2500	1000	193	193	8,3	193	135

For other materials consult KSB.

7.6 Spare parts stock

When ordering spare parts, please indicate pump type and size, Production Order number, part number and designation. This information can be obtained from the Data Sheet, Sectional Drawings and Parts List.

7.6.1 Recommended Spare parts for a 2 years operation to DIN 24296.

Part N°	Denomination	Number of pumps (including stand-by pumps)						
		2	3	4	5	6	8	10 or more
		Spare Parts Quantity						
211/212/213	Shafts	1	1	2	2	2	3	30%
230	Impeller	S-1	S-1	2x (S-1)	2x (S-1)	2x (S-1)	3x (S-1)	30%
231	Suction impeller	1	1	2	2	2	3	30%
320	Bearing	1	1	2	2	3	4	50%
330	Bearing bracket	-	-	-	-	-	1	2 parts
383	Spider bearing	1	1	2	2	2	3	30%
411	Gasket, complete (set)							150%
412	O´ring complete (set)	1	1	2	2	3	4	50%
433	Mechanical seal	1	1	1	2	2	2	20%
461 ①	Gland packing (set)	4	4	6	6	6	8	100%
502	Casing wear ring	2	2	2	3	3	4	50%
503	Impeller wear ring	2	2	2	3	3	4	50%
524	Shaft protective sleeve	1	1	1	2	2	2	20%
529	Bearing sleeves, complete	1	1	2	2	3	4	50%
545	Bearing bushes, complete	1	1	2	2	3	4	50%
840	Coupling	1	1	2	2	2	3	30%
---	Gaskets and O'rings sets	4	6	8	8	9	12	150%

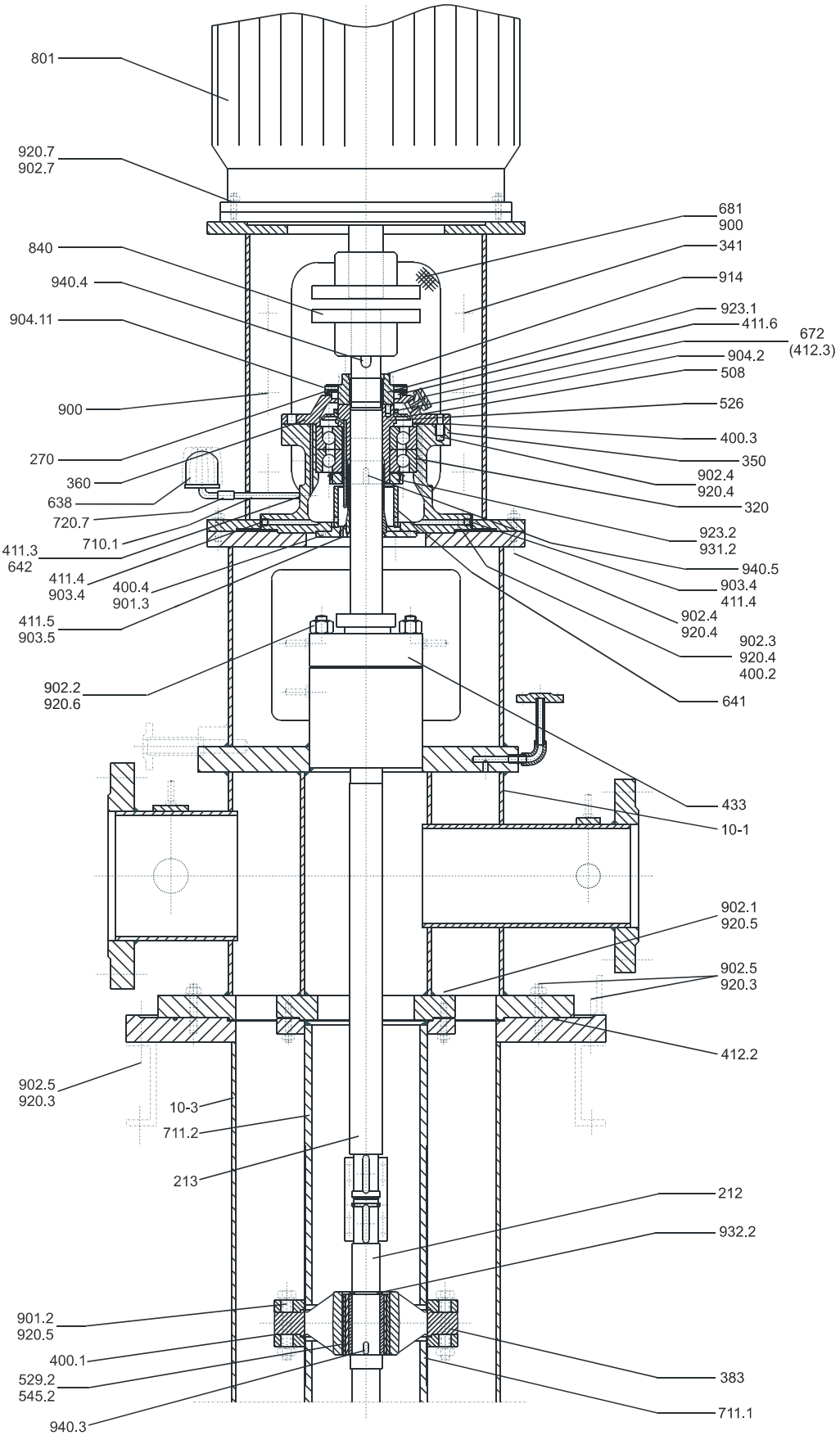
① If fitted
S = number of stages

8. Troubleshooting

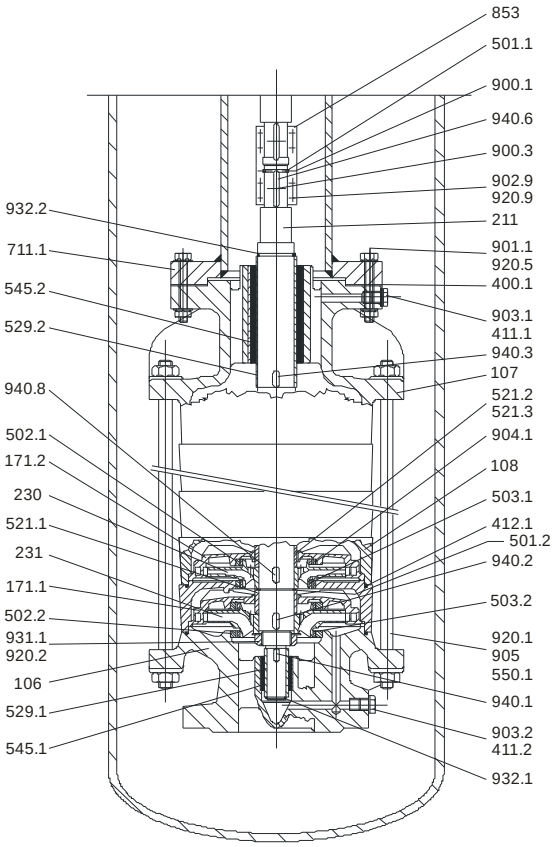
Pump delivers insufficient flow rate	Motor is overloaded	Excessive pump discharge pressure	Increase in bearing temperature	Leakage at the pump	Excessive leakage at the shaft seal	Vibration during pump operation	Excessive rise of temperature inside the pump	Cause	Remedy [1]
•								The pump generates an excessively high differential pressure.	Open discharge valve further until the duty point conditions have been attained.
•								Excessively high back pressure.	Fit larger impeller (s) Increase speed (applies to turbine driven or I.C Engine driven pumps)
•						•	•	The pump or piping are incompletely vented or primed.	Vent or prime the pump and piping completely.
•								Suction line or impeller (s) clogged.	Remove deposits in the pump and/or piping.
•								Formation of air pockets in the piping.	Alter piping layout. If necessary fit a vent valve.
			•		•	•		The pump is warped.	Check piping connections and pump fixing bolts.
•						•	•	NPSH available is too low (on positive suction head installations).	Check liquid level in suction vessel. Open isolating valve in suction line fully. Alter suction line if necessary, if the friction losses in the suction line are excessive. Check suction line strainer. Make sure that the permissible rate of pressure decrease is not exceeded.
			•					Increased axial thrust. [2]	Clean out balance holes in impeller. Fit new casing wear rings.
•								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 electric connections.
•								Rotational speed is too low. [2]	Increase speed. Increase voltage.
						•		Defective bearings.	Fit new bearings.
			•			•	•	Insufficient rate of flow.	Increase the minimum rate of flow.
•						•		Excessive wear of the pump internals.	Replace worn components by new ones.
	•					•		Pump back pressure is lower than specified in the purchase order.	Adjust duty point accurately by means of the isolating valve in the discharge line. In case of persistent overloading, trim the impeller (s) if necessary [2]
	•							Specific gravity or viscosity of the fluid pumped is higher than that specified in the purchase order.	[2]
	•				•			Use of unsuitable materials.	Change the Material combination.
		•						Excessive rotational speed.	Reduce speed (applies to turbine driven or I.C. engine driven pump). [2] [3]
				•				The connection bolts are slack.	Tighten the bolts. /Fit new gaskets
					•			Worn shaft seal.	Check condition of shaft seal and renew it if necessary. Check flushing liquid or sealing liquid pressure
•					•			Grooving, score marks or roughness or shaft sleeve surface.	Fit new shaft sleeve.
					•			Lack of cooling liquid or fouled and clogged cooling liquid compartment.	Increase the flow of cooling liquid. Clean out the cooling compartment. Clean the 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.
			•		•	•		Pump set is misaligned.	Check alignment at coupling and realign the set if necessary.
			•					Too much, too little, or unsuitable lubricant quality.	Reduce quantity of or top up lubricant or change lubricant quality.
			•					The specified coupling gap has not been maintained.	Restore correct coupling gap in accordance with the data on the installation plan.
	•							Operating voltage is too low.	Increase the voltage.
						•		Rotor is out of balance .	Clean the rotor. Rebalance the rotor dynamically.

1) Pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.
2) Request particulars.

9. Sectional drawing (part 1/2) - reference



Sectional drawing (part 2/2) - reference



Main parts list

Description	Part nº	Description	Part nº	Description	Part nº
Distributor casing	10-1	*) Casing wear ring	502.2	Stud	902.3
Suction can	10-3	Impeller wear ring	503.1	Stud	902.4
Suction casing	106	Impeller wear ring	503.2	Stud	902.5
Discharge casing	107	Oil thrower	508	Stud	902.7
Stage casing	108	Stage sleeve	521.1	Stud	902.9
Diffuser	171.1	Stage sleeve	521.2	Threaded plug	903.1
Diffuser	171.2	Stage sleeve	521.3	Threaded plug	903.2
Pump shaft	211	Centering sleeve	526	Threaded plug	903.4
Intermediate shaft	212	*) Bearing sleeve	529.1	Threaded plug	903.5
Drive shaft	213	*) Bearing sleeve	529.2	Threaded pin	904.1
Impeller	230	Bearing bush	545.1	Threaded pin	904.2
Suction impeller	231	Bearing bush	545.2	Threaded pin	904.11
Deflector	270	Disc	550.1	Tie bolt	905
Antifriction bearing	320	Disc	550.2	Socket head screw	914
Drive stool	341	Constant level oiler	638	Hex. nut	920.1
Bearing housing	350	Oil level pipe	641	Nut with two flats	920.2
Bearing cover	360	Oil level indicator	642	Hex. nut	920.3
Bearing spider	383	Venting	672	Hex. nut	920.4
Flat gasket	400.1	Coupling guard	681	Hex. nut	920.6
Flat gasket	400.2	Pipe	710.1	Hex. nut	920.7
Flat gasket	400.3	Riser pipe	711.1	Hex. nut	920.9
Flat gasket	400.4	Riser pipe	711.2	Hex. nut	920.11
Joint ring	411.1	Pipe double nipple	720.1	Bearing nut	923.1
Joint ring	411.2	Pipe double nipple	720.7	Bearing nut	923.2
Joint ring	411.3	Flange motor	801	Lock washer	931.1
Joint ring	411.4	Coupling	840	Lock washer	931.2
Joint ring	411.5	Muff Coupling	853	Circlip	932.1
Joint ring	411.6	Screw	900	Circlip	932.2
O-ring	412.1	Screw	900.1	Key	940.1
O-ring	412.2	Screw	900.3	Key	940.2
O-ring	412.3	Hex. head bolt	901.1	Key	940.3
Mechanical seal	433	Hex. head bolt	901.2	Key	940.4
Multiple ring	501.1	Hex. head bolt	901.3	Key	940.5
Multiple ring	501.2	Stud	902.1	Key	940.6
*) Casing wear ring	502.1				

*) Additionally recommended spare parts

Recommended spare parts

Supplementary sheet

Pump with impeller wearing rings and interstage bushes (see fig.01)
Pump sizes 40 to 150, pressure rating 20/40.

Supplements for sections:

Examination of individual components

Pump Body
Suction casing (106), discharge casing (107), stage casings (108), impellers (230,231), impeller wearing rings (503), casing wearing rings (502), interstage bushes (541), distance bushes (521), or sleeves (520) with pump size 150.

Ensure all the sealing faces are in perfect condition. Check the plane parallelism of the faces at 4 points on the circumference with a micrometer. The deviation must not exceed 0,02mm. Damaged faces can be machined on a lathe.
The surface roughness must not exceed 0, 8 microns.

The impellers (230, 231), stage casings (108), and diffusers (171), are fitted with renewable wearing parts – impeller wearing rings (503), casing wearing rings (502), and interstage bushes (541). Check the wearing parts for galling and check the rotor clearances per figs. 5 and 6.

The wearing parts must only be machined when fitted and the maximum permissible clearances must be respected. Any increase in clearance must be made uniform at all wearing parts inside the pump.

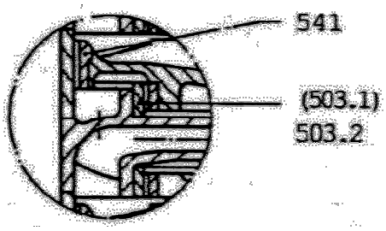


Fig. 01 Full Chrome design with impeller wearing rings and interstage bushes, pressure rating 20/40.

If the rotor clearances are the same as or greater than the max. permissible clearances specified in figs. 5 and 6, fit new oversizes wearing parts and reestablish the “as new” clearances.

Fitting new casing wearing rings (502):

1. Undo the allen grub screw, press the casing wearing rings in the stage casing and diffuser out of the fit, taking care not to damage the fit (see fig. 02).
2. Uniformly, press new oversized casing wearing rings (normally 2 mm allowance) into the bore (cooling the rings makes this easier).
3. Smooth down all impellers (230, 231) in the region of the fitted impeller wearing rings (503) to a common diameter, basing this on the most heavily scored impeller wearing ring. Single deep grooves can be left untouched (see fig. 03).
4. Calculate the average actual diameter of all smoothed down impeller wearing rings. Adding this to the “as new” clearance per figs. 4 and 5 gives the bore diameter for the casing wearing rings, tolerance + 0,04mm.

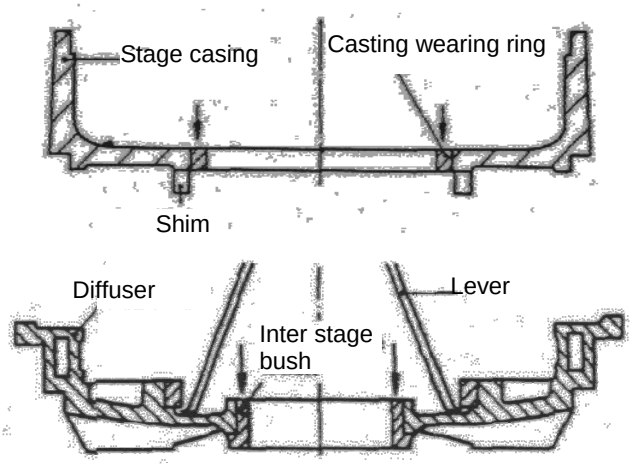


Fig. 02 Renewing the casing wear rings and stage bushes

5. Align the stage casing (108) and diffuser (171) with fitted casing wearing ring to the outer fit and machine the wearing ring without changing setting.

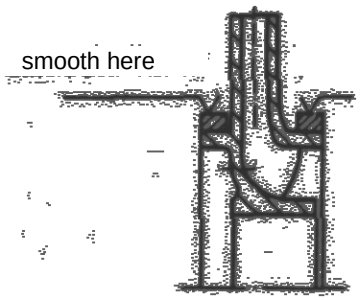


Fig. 03 Smoothing out the throttle sections on the impeller wearing rings.

Clearances

Pump sizes	Operating temperature °C	Clearances for material combination	
		0,6 “as new”	1,2 max. perm.
40 to 150	0 to +200	AISI 420/AISI 420 (Hard)	

Fig. 04 Impeller wearing ring / casing wearing ring clearances; mm on Ø

Pump sizes	Operating temperature °C	Clearances for material combination	
		0,6 “as new”	1,2 max. perm.
40 to 150	0 to +200	AISI 420/AISI 420 (Hard)	

Fig. 05 Distance bush / interstage bush clearance, mm on Ø

ANNEX 01

Certificate of decontamination

Type .....
Order number / .....
Order item number [1] .....

Delivery date .....

Field of application: .....

Fluid handled [1]: .....

Please tick where applicable " X " [1]:


☐ radioactive


☐ explosive


☐ corrosive


☐ toxic


☐ harmful


☐ bio-hazardous


☐ highly flammable

☐ safe

Reason for return [1] .....
.....

Comments: .....

The pump / accessories have been carefully drained, cleaned and decontaminated inside and outside prior to dispatch / placing at your disposal.

On seal-less pumps, the rotor has been removed from the pump for cleaning.

No special safety precautions are required for further handling
The following safety precautions are required for flushing fluids, fluid residues and disposal:

.....
.....

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

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

.....
[1] Required fields

16.05.2013

A1766.8E/2

KSB Bombas Hidráulicas SA
Rua José Rabello Portella, 400
Várzea Paulista SP 13220-540
Brazil http://www.ksb.com
phone.: 55 11 4596 8500 Fax: 55 11 4596 8580
SAK – KSB Customer Service
e-mail: gqualidade@ksb.com.br
Fax: 55 11 4596 8656