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1. General

Your centrifugal pumps will give you completely trouble free and satisfactory service on condition that it is installed with due care and properly maintained. It is absolutely essential that the instructions contained in this manual be scrupulously observed and that the pumps are not operated under conditions which differ from those specified under our 'Operating Conditions'. This operating instruction manual does not take any account of any safety regulation which may apply to the installation site, and the Site Engineer or Site Operator is responsible for notifying our erection staff of any such regulations and seeing that they are complied with.

The pump type size, main operating data and works order number are all stamped on the name plate affixed to the pump. Please make sure to quote this information every time you write to us in respect of queries, repeat orders and particularly when ordering spare parts.

1.1 Handling

The Pumping set should be properly handled and slung for transport. Do not thread the ropes through the eye bolt on the motor. (See Fig. 1)

During handling do not remove the rubber blankings provided on the suction and discharge nozzles.

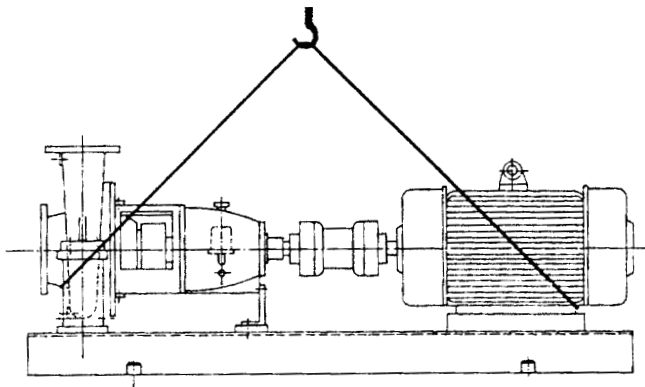


Fig. 1 : Pump and driver mounted on a combined baseplate

2. Installation (on site)

2.1 Foundation

Make sure that the concrete foundation has set firmly before placing the base frame along with the pump set or pump on it. The surface of the foundation should be truly horizontal and perfectly flat. The foundation bolts should be suspended in the baseplate.

2.2 Base Frame and Pump

Procedure

1. Bolt the Pump on the base frame.
2. Bolt the packer plates on the bottom pads of the base frame, if applicable.
3. Place the unit on the foundation.
4. Suspend the foundation bolts in the pockets provided on the foundation block.
5. Level the pump on the delivery flanges or feet within 0.04 mm per mtr., using jacking bolts provided on the corners of the base frame.

6. Grout the foundation bolts and the packer plate (if applicable) by using quick setting non-shrink cement, ACC make "Shrinkkomp" or FORSORC make "Conbextra-GP2" or equivalent.
7. Allow curing time of 24 to 72 hours depending upon the grout used.
8. Remove bolts which are holding packer plates with the baseframe (if applicable).
9. Carry out final levelling by inserting shims (SS Shims preferred) between packer plates and baseframe (if applicable).
10. Tighten the foundation bolts and recheck the levelling. Correct it, if necessary.
11. Grout the complete baseframe, including hollow portion, if any, using conventional grouting mix i.e. portland cement, sand and aggregate in proportion 1:2:4 and gravel size not exceeding 20 mm.
12. Plaster the foundation and apply suitable oil resistant paint.

For figures refer Annexure I.

2.3 Alignment of pump and driver

Accurate coupling alignment requires the manufacture of a coupling alignment jig. This can be manufactured from 20 x 20 mm steel flat. The jig should be attached to the shafts. See Fig. 2.

The coupling can be considered correctly aligned with the aid of the jigs illustrated if the difference measured does not exceed 0.04 mm both in the radial and axial directions, measurements being taken in 4 places at 90° intervals. Alignment should be checked when the pump is hot (applicable for pump handling not fluids). In case any deviation is found, please check the pipe lines and or realign the pump. The coupling alignment check should be repeated after the piping has been connected to the pump to ensure stress free piping. Prior to alignment, individual concentricity of coupling should be checked. It should be within 0.03 mm. If not, corrective action should be taken. The coupling should be dynamically balanced in accordance with VDI 2060 (ISO 1940)/G6.3 for motor driven pumps and G2.5 for turbine driven pumps.

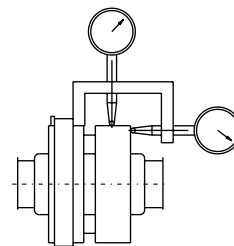


Fig. 2 : Alignment of coupling

2.4 Connecting the piping

Never use the pump itself as an anchorage point for the piping. Suction lift lines should be laid with a rising slope towards the pump and suction head line with a downward slope towards the pump. The pipelines should be anchored in close proximity to the pump and should be connected to the latter without transmitting any stress or strain, nor should the weight of the piping be loaded on to the pump. The nominal sizes of the pipelines should be at least equal to the nominal sizes of the pump nozzle. In case the suction pipeline size is bigger, the connection should be done by means of an

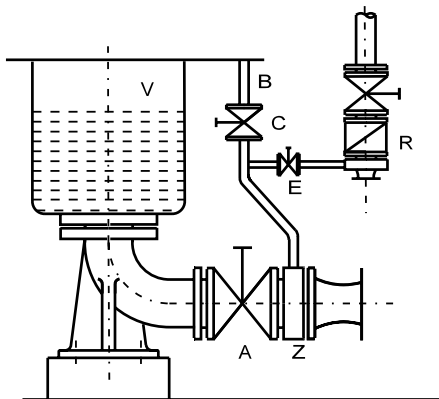
eccentric reducer, in order to avoid air pockets. We recommended the incorporation of check valves or non return valves and isolating valves in the system, depending on the type of installation and pump. Any thermal expansion of the piping (due to high temperatures) must be compensated by suitable means, so as not to impose any additional load on the pump.

2.4.1 Auxiliary Connections

The auxiliary connections required for your pump (cooling, heating, sealing liquid, flushing liquid etc. as the case may be) are indicated in the installation drawing and on the piping diagram in respect of size and location.

2.4.2 Vacuum Balance Line

If the pump has to pump a liquid out of a vessel under vacuum, it is advisable to install a vacuum balance line. This line should have a nominal size of 25 mm at least. It should be arranged to lead back into the vacuum vessel at a point above the highest permissible liquid level. An additional line starting at the pump discharge nozzle facilitates venting of the pump before start up. The vacuum-tight isolating valve E in this connecting line should be closed after the venting procedure & should remain closed while the pump is running. The main isolating valve C in the vacuum balance line must remain open at all times when the pump is running and should be closed when the pump is shutdown. Refer Fig. 3.



- A Main isolating valve
- B Vacuum balance line
- C Isolating valve
- E Vacuum-tight isolating valve
- R Check valve
- V Vessel under vacuum
- Z Intermediate flange

Fig. 3 Suction line and vacuum balance line

2.5 Coupling Guard

In compliance with the accident prevention regulations, the pump may only be operated if it is fitted with a coupling guard. If the customer states specifically that coupling guard is not to be supplied by KSB, it must be provided by the pump operator.

2.6 Measuring Instruments

Each pump should be equipped with two pressure gauges, one at the suction nozzle and the other at the discharge nozzle. Their measuring range should be suitable for the prevalent pressure conditions, and they should be provided with a stop cock or stop valve. If the suction conditions demand (e.g. suction lift operation), the gauge on the suction nozzle should be pressure vacuum gauge.

2.7 Final check

Check the alignment once more as described in section 2.3. It must be possible to rotate the pump rotor freely without additional effort by hand at the coupling.

3. Commissioning, Start-up/Shutdown

3.1 Preliminary remarks regarding commissioning

3.1.1 Lubricants

The bearing bracket should be filled with oil of any one of the following types and specifications :

Indian Oil	:	Servosystem 46
Hindustan Petroleum	:	Enklo 46
Bharat Petroleum	:	Bharat Hydrol 46

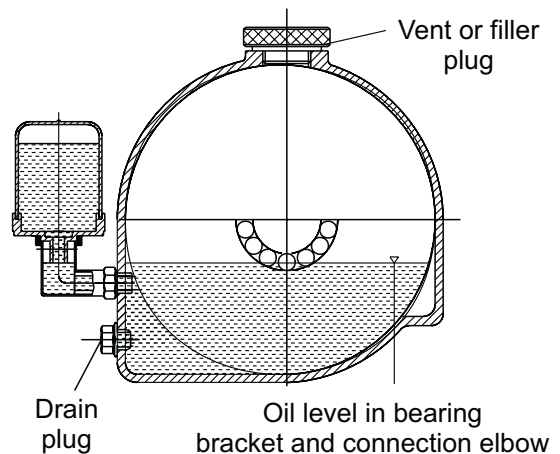


Fig. 4 : Oil fill

Procedure

Unscrew vent plug. Pour in oil through the vent plug aperture after removing the reservoir of the constant level oiler, until oil appears in the vertical portion of the connection elbow of the constant level oiler (see fig. 4).

Then fill the reservoir of the constant level oiler with oil and fit it back into operating position. Screw vent plug in again. After a short time has elapsed, check whether the oil level in the reservoir has sunk. The reservoir should always remain filled. If the vent plug is inaccessible or difficult to reach e.g. the oil can be filled into the bearing bracket through the connection elbow of the constant level oiler.

Caution :

The oil level fill should always be situated below the level of the vent slot arranged at the top edge of the connection elbow and this slot should always be perfectly dry. Do not tighten the elbow by applying force on the reservoir use lock nut for this purpose.

3.1.2 Shaft Seal

The shaft is sealed at its exit through the casing by a soft packed stuffing box or a mechanical seal. Changeover from gland packing execution & viceversa is possible by using conversion kit. For details refer KSB.

3.1.2.1. Stuffing Boxes

Soft-packed stuffing boxes reduce the flow of leakage liquid at the clearance gap between casing cover and shaft protection sleeve when the pressure inside the pump is higher than atmospheric. Conversely, on pumps which operate on suction lift pressure, the soft-packed stuffing box prevents the ingress of air into the pump. Sealing is effected by means of soft packings arranged in a number of rings in the annular space between the casing cover (161) and the shaft protection sleeve (524) and lightly compressed by the stuffing box gland (452). Refer Fig. 6.

3.1.2.2 Cooling of Casing Cover

The casing cover jacket of soft packed stuffing boxes must be cooled if the temperature of pumped fluid exceeds 90°C (194°F).

Clean, clear and non aggressive water is recommended for cooling (pH \approx 7). The maximum pressure of cooling water is 10 bar. The cooling water quantities are specified in lpm for $\Delta t = 15^\circ\text{C}$ in Table No. 1.

Inlet temp. : 10°C to 30°C

Outlet temp. : 45°C max.

Bearing Bracket	Quantity of cooling water in LPM		
	Temperature of pumping liquid		
	Upto 150°C	150° to 250°C	above 250°C
P 25/62	5	6	8
P 35/80	6	8	9
P 45/120	9	11	12
P 55/140	12	14	15
P 65/160s	15	17	18

3.1.2.3 Packing the Stuffing Boxes

Caution :

The pump is despatched from our Works with the stuffing boxes packed.

Before repacking, thoroughly clean stuffing box gland (452), packing compartment and shaft protection sleeve (524).

Cut the packing rings to correct length and ends at 45°. Ensure that the packing rings ends come into contact with one another on fitment. (See Fig. 5)

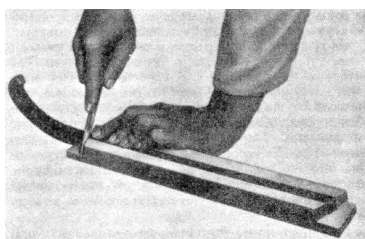


Fig. 5 Cutting the packing rings to length.

If the packing rings are either too long or too short, the stuffing box will not be able to perform its function properly. In the case of asbestos-graphite packing material, the rubbing faces of the individual rings should be lightly coated with Molykote before insertion in the packing compartment. The first packing ring is then inserted and pushed home into the compartment with aid of the stuffing box gland (452).

The following packing rings are then inserted into the packing compartment one by one, making sure that the butt joint of each ring is offset by 90° approx. in relation to the butt joint of the preceding ring. The individual rings are pushed home into the packing compartment with the aid of the stuffing box gland (452). The packing rings should only be pressed lightly against one another. They should be inserted in the packing compartment in such a way that a clear gap of 6 to 8 mm is left at the outer end of the compartment for the positive guidance of the stuffing box gland (452).

The inserted packing rings should then be compressed moderately with the aid of the stuffing box gland (452) and the nuts (920.03). Then the nuts (920.03) should be slackened again by one to two complete turns, and thereafter tightened lightly by hand. The correct and even seating of the stuffing box gland (452) should be checked when the pump is subjected to suction pressure, by inserting a feeler gauge between the stuffing box gland (452) and the shaft protection sleeve (524).

In the case of the special stuffing boxes, a lantern ring is also inserted in the packing compartment, at the centre of the compartment (between the packing rings). In these cases, an information plate is affixed to the casing cover (161), showing the position of the lantern ring. The lantern ring must register beneath the drilled hole in the casing cover (161), to enable the sealing liquid to enter. The pressure of the liquid should be 1 to 4 bar above the pressure existing in the packing compartment of the stuffing box.

The packing of the stuffing box should be carried out with great care, to avoid an excessively high radial pressing force of the packing rings against the shaft protection sleeve, which might damage the latter. If the shaft protection sleeve is scored or grooved, even a new packing cannot be expected to last very long in service.

A newly packed stuffing box should leak profusely at first. If this leakage does not cease of its own after a relatively short period of operation, the nuts on the stuffing box (452) gland should be tightened slowly and evenly while the pump is running, until the stuffing box only drips slightly. Make sure that the stuffing box gland (452) is tightened evenly and not askew, as otherwise the shaft protection sleeve (524) might be damaged.

If the newly packed stuffing box starts to emit smoke when the pump is started up for the first time, the pump should be switched off. If the smoking persists after the pump has been started up again and operated several times in succession, the nuts on the gland should be slackened slightly, or the stuffing box should be inspected if necessary.

3.1.2.4 Packing Material

When selecting the packing material, make sure it is compatible with the fluid pumped (consult the manufacturer in case of doubt).

Packing material which has been kept in store for a certain period has a longer service life than standard fresh packing material from the packing manufacturer. Packing matts fitted in the pump while despatching are :-

- CPK G/GC : Style 1003
- E/EC : Style 1003
- C : Style 1003
- CPKEY : Graphoil

3.1.2.5 Sealing liquid

In case of soft packed pumps working under vacuum, handling impure liquids, sealing liquid is required to be fed through lantern ring connection. For this the GA drawing of the pump should be referred to.

3.1.3 Priming the pump

The pump suction lift line must be vented and primed with the fluid pumped before start-up. The isolating valve in the suction lift line must be fully open. All auxiliary connections provided on your pump (e.g. flushing liquid, sealing liquid, cooling liquid etc.) must be opened fully and the unimpeded flow through these lines must be verified. Open the isolating valve in the vacuum balance line (if applicable to your installation) and close the vacuum tight isolating valve 'E' (Fig. 3).

3.1.4 Checking the direction of rotation

The direction of rotation must correspond to the arrow on the pump. This can be checked by switching on the driver for a short instant and switching it off again immediately. Mount the coupling guard after checking the direction of rotation.

3.2 Start up

Always make sure that the isolating valve in the discharge line is closed when the pump is switched on. Only after the pump has attained full operating speed should the discharge valve be opened gradually and the operating point conditions adjusted by means of this valve.

Caution :

After the operating temperature has been attained and/or in the event of leakage, tighten the Bearing bracket lantern to casing connection bolts after switching off the pumping set. If the leakage persists, check/change the gasket.

3.3 Shut down

Close isolating valve in the discharge line. If non-return valve or a check valve has been incorporated in the discharge line, the isolating valve can remain open so far as there is a back pressure present in the line. Switch off driver. Observe the pumping set running down smoothly and quietly to a standstill.

In the event of a prolonged shutdown, the isolating valve in the suction lift line should be closed.

The shaft seal of pumps which are connected to a supply vessel under vacuum must be fed with flushing liquid even when the pump is switched off. In the event of frost and/or of prolonged shutdowns, the pump and the cooling compartments (if applicable) must be drained or otherwise protected against freezing using suitable antifreeze solution.

4. Maintenance and lubrication

4.1 Supervision of operation

The pump should run quietly and free from vibration at all times. The pump must never be allowed to run dry. Avoid any prolonged running against a closed discharge valve.

The bearing temperature may be allowed to attain upto 50°C above room temperature but should not exceed 80°C.

Make sure the oil level is adequate (see section 3.1.1). The isolating valves in the auxiliary feed lines must always remain open when the pump is running.

The soft packed stuffing box (if your pump has one) should drip slightly during operation. The stuffing box gland should only be tightened lightly.

Any standby pumps in the pumping installation should be operated once a week for a short instant, by switching on and switching off again, so as to maintain them in good condition for instant start-up in case of emergency. The correct functioning of the auxiliary connections should be kept under observation. When signs of wear become apparent on the flexible coupling elements in the course of time, these element should be replaced by new ones in good time. Otherwise unbalance vibration will increase leading to failure of coupling.

It is necessary to maintain a log book on hourly basis, where the suction and discharge pressure, flow rate, bearing temperatures (pump end and motor end), motor current and voltage should be noted.

4.2 Bearings and lubrication

4.2.1 Lubricant Quantities

The antifriction bearings are oil lubricated; Required lubricant fills for diff. brg. bkts are as under :-

Standard Bearing Assembly

Bearing bracket	Deep groove ball bearings 321.01/02 DIN 625/C3 bearing clearance	Oil fill in litres
P25/65	6305 C3	0.2
P35/80	6307 C3	0.5
P45/120	6409 C3	0.5
P55/140	6411 C3	1.5

Heavy duty bearing assembly

Bearing Bracket	Cylindrical roller bearing 322	Angular contact ball bearing 320	Oil fill in litres
P25/62s	NU305 C3	7206BG	0.2
P35/80s	NU307 C3	7307BG	0.5
P45/120s	NU311 C3	7311B.TVP.UA80	0.5
P55/140s	NU313 C3	7313B.TVP.UA80	1.5
P65/160s	NU413	7315B.TVP.UA80	1.8

Table No. 2 Arrangement of bearings & quantity of oil.

Note : For correlation of pump size & bearing bracket refer 5.4.3.

4.2.2 Oil changes

The first oil change should be carried out after 300 hours of operation approx. and subsequent oil changes once every 3000 hours of operation approx. In case of newly replaced bearings, the oil should be changed after 200 hours of running and thereafter every 1000 working hours.

4.2.3 Procedure

Unscrew oil drain plug beneath the constant level oiler and drain off the old oil. When the bearing bracket is empty, replace the oil drain plug and fill in fresh oil in accordance with section 3.1.1.

4.3 Preservation

If the pump is taken out of service for a prolonged period, it is advisable to dismantle it completely. Proceed as described in section 5.1.2 "Dismantling". All components should be thoroughly cleaned, dried and all bright components coated with grease. Thereafter the pump should be reassembled. All apertures on the pump should be plugged with wooden cover plates fitted with O rings. A sachet filled with silicagel (silicagel absorbs moisture) should be attached to the inside faces of the oil soaked wooden cover plates on the suction and discharge nozzles (i.e. inside the nozzles).

The packing should be removed from the stuffing box compartment and it should be sealed by oil-soaked wooden half tubes, each provided with two O-rings, in order to prevent the penetration of moisture (not applicable to pumps fitted with mechanical seals).

Caution :

Use acid free oils and greases only, when preserving the pump.

5 Special Instructions and Recommendations

5.1 General Precautions

Before commencing dismantling .

Make sure that the pump will not be accidentally switched on.

The isolating valves in the suction and discharge line must be closed.

The volute casing must have cooled down to ambient temperature. The volute casing must be drained and pressureless.

Always refer to the relevant sectional drawing when dismantling and reassembling the pump.

5.1.2 Dismantling

5.1.2.1 Soft-packed stuffing box

Refer fig. 7

1. Drain the oil in accordance with section 3.1.1.
2. Remove the coupling guard.
3. Disconnect coupling spacer, or if no spacer is fitted remove the driver.
4. Disconnect and remove the auxiliary connections on your pump.
5. Loop a rope tightly around the top stay of brg bkt. lantern.
6. Unscrew hex head bolt 901.02 and the base frame fixing bolts of support foot 183 and remove the support foot.
7. Unscrew hex nuts 920.01 and pull the complete bearing bracket together with casing cover, shaft, impeller and bearing bracket lantern out of the volute

casing. Use jack bolts for assistance in doing this having first cleaned the threads. Take care not to damage gasket 411.03.

8. Unscrew impeller nut 922 with its Heli-coil insert (right handed screw thread), remove gasket 411.31 and washer 551.13, pull off impeller 230, remove key 940.01.
 9. Remove stuffing box gland 452 together with stuffing box pressure ring 454 after having unscrewed hex nuts 920.02.
 10. Remove Casing cover 161 remove gaskets 411.10 & O-ring 412.01. Next remove stuffing box packing 461 & lantern ring 458. Then remove neck ring after unscrewing screws 900.
 11. Pull shaft protection sleeve 524 together with gasket 411.32 & washer 551.32 and splash ring 507 off the shaft.
 12. Unscrew hex nuts 920.02 and remove bearing bracket lantern, (344).
 13. After having unscrewed allen head screw in the coupling hub, pull the coupling half of the pump shaft with the aid of an extractor device and remove key 940.02.
 14. After having unscrewed Allen head screws (914.01/02) in coupling hub dismantle bearing covers 360.01 and 360.02 at pump and drive ends together with flat gaskets (400.01/02), oil seals (421.01/02) / Lantern rings (423.01/02) as applicable.
- 14.1 Standard bearing assembly :**
- 14.1.1 Carefully remove the shaft 210 together with deep groove ball bearing 321.02 out of the bearing bracket.
 - 14.1.2 Heat up the deep groove ball bearings and pull them off the shaft.
- 14.2 Heavy duty bearing assembly :**
- 14.2.1 Carefully remove the shaft 210 together with angular contact ball bearings 320 and inner race of cyl. roller bearing 322 towards the drive end of the pump.
 - 14.2.3 Remove roller cage of cyl roller brg (322) from the bearing bracket. Then remove spacer ring 504.2 & circlip.
 - 14.2.4 Bend back lock washer 931; unscrew bearing nut 923 (righthanded screw thread) remove lock washer.
 - 14.2.5 Heat up angular contact ball bearings 320 and the inner race of cyl. roller bearing 322 and pull them off the shaft. Remove spacer ring 504.01 (applies only to bearing bracket size 25/62s).
 - 14.2.6 Clean all the components and examine them for signs of wear. Touch up the damaged components or replace them by new ones, if necessary.

5.1.2.2 Mechanical seal stuffing box :

1. Unscrew hex nuts 920.2 and pushback mechanical seal cover 471 until it abuts against splash ring 507.
2. Dismantle casing cover 161 together with O - ring 412.1
3. Pull the complete mechanical seal together with shaft protection sleeve 524, mechanical seal cover 471, and splash ring 507 off the shaft.

5.1.3 Reassembly

The pump should be reassembled in accordance with the rules of sound engineering practice. The fits of individual components should be coated with graphite or other suitable lubricants before assembly and the same applies to screwed connections.

O-rings and radial shaft seal rings should be examined for signs of damage and replaced by new ones, if necessary. Flat gasket should in principal be replaced by new ones and make sure that the thickness of the new gasket is exactly the same as that of the old one.

Reassembly proceeds in reverse sequence to dismantling. The following points should be carefully observed.

Use only the bearing types and sizes specified in section 4.2.1. The antifriction bearings 320/321.01/02 and inner race of antifriction bearing 322 (when applicable) should be preheated in an oil bath to 80°C approx. before being slipped on to the shaft until they abut against the shaft shoulder.

Caution :

1. For heavy duty bearing bracket, the antifriction bearings 320 must be mounted in O-arrangements (see sectional drawing) Remember the spacer rings 504.01/02 for normal/heavy brg bkts.
2. When the bearings 320 have been mounted, the bearing nut 923 without the lock washer 931, must be screwed on firmly with the aid of a hook spanner. (Do not use a hammer).
3. The bearing nut must be removed again, the lock washer inserted and the bearing nut screwed on firmly again with the hook spanner (Do not use a hammer). Bend lock washer forward to lock the nut.
4. Take care not to damage the oil seal rings 421.01/02 (when applicable) when mounting bearing covers 360.01/02.
5. The impeller nut should be tightened firmly. The impeller nut should be tightened a new some 20 to 30 minutes after the initial tightening. Refer Annexure II for details of metallic washer fitment in impeller.
6. After assembly into the volute casing which has remained in situ in the piping the coupling alignment should be checked (see section 2.3).
7. Fill in oil in accordance with section 3.1.1.

5.1.3.1 Reassembly of stuffing box packing

Assembly recommendations (when pump is dismantled) Clamp casing cover 161 in a vice, or keep it on an assembly table and slip in neck ring 456. Then insert the first packing ring with its butt joint lying in the horizontal plane.

Hold the packing ring tight and slip the shaft protection sleeve into the packing compartment from the pump end, chamfered end first. Open out the internal diameter of the packing ring slightly with the aid of the shaft protection sleeve by sliding the latter to and fro. Then pull out the shaft protection sleeve and insert the second packing ring with its butt joint offset 90° in relation to the butt joint of the first packing ring. Repeat the opening out process with aid of the shaft protection sleeve.

Then insert lantern ring 458 (if fitted to your pump). Then insert the remaining packing rings in succession with their butt joints offset, and repeating the opening out process for each ring. When the last packing ring has been inserted the shaft protection sleeve should be left in the packing compartment. Insert stuffing box ring 454 in such a way that its joint face is at right angles to the stuffing box gland. Slip stuffing box gland 452 and tighten it lightly only by hand, by means of two hex nuts 920.02.

Mount the completely packed casing cover together with the shaft protection sleeve into the pump.

Caution :

The stuffing box should drip slightly when the pump is running.

Any sealing and cooling liquid connections which are in use must be checked in respect of unimpeded fluid flow from time to time.

When the stuffing box gland has been tightened repeatedly (during use) until it abuts, it is time to repack the pump completely with new packing.

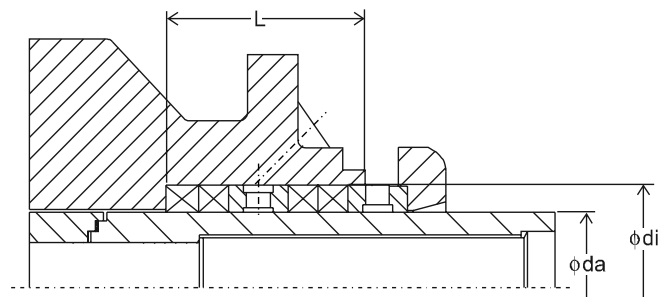


Fig. 6 Stuffing box dimensions

Bearing bracket	Dimensions of Packing compartment in mm.			Cross Section packing in mm.	Packing rings
	Ø di	Ø da	L		
P25/62	35	51	53	8 x 8	4 rings and 1 lantern ring or
P35/80	45	65	64	10 x 10	
P45/120	55	75	64	10 x 10	
P55/140	70	95	79	12.5 x 12.5	6 rings w/o lantern ring
P65/160s	80	105	79	12.5 x 12.5	

Table No. 3

See section 5.4.3 for correlation between pump and bearing bracket sizes.

5.1.3.2 Reassembly of Mechanical seal

Mount the mechanical seal as described in the instructions of seal manufacturer. The following points should be observed when mounting the mechanical seal :

Extreme care and cleanliness during assembly are the essential prerequisites for the trouble free operation of the mechanical seal.

The guard protecting the sealing faces should only be removed only at the time of its fitment before assembly.

When the stationary seal ring has been inserted, check its plane parallelism in relation to the casing cover. The surface of the shaft protection sleeve must be absolutely clean and smooth and mounting edge of the sleeve must be chamfered.

When slipping the rotating assembly of the seal on to the shaft protection sleeve take suitable steps to protect the surface of the shaft protection sleeve against damage.

Before final mounting in the pump, the rubbing faces of the mechanical seal should be wetted with a drop or two of silicon oil. In the case of pumps equipped with a double acting mechanical seal, the mechanical seal compartment must be properly vented and pressurized to the correct pressure specified in the installation drawing (it should remain under pressure even when the pump is stopped).

The supply of quench liquid must remain turned on even when the pump is stopped.

5.2 Cooling / Heating

Clean, clear and non-aggressive water is recommended for cooling. Recommended pH value is 7.

Cooling to stuffing box :

Please follow the instruction given in point no. 3.1.2.2 on page 3 of this manual.

Sealing liquid / cooling of stuffing box gland :

For stuffing box with packings, clean solid free liquid at a pressure of 1 bar above the pressure in stuffing box and at a flow rate of 2-3 lpm is recommended.

Pressure (maximum) : 6 bar

Recommended temperature : 10 °C to 30 °C.

Cooling to bearing bracket :

No cooling shall be given to the bearing bracket up to a working temperature of 200 °C.

For working temperature > 200 °C, use following data :

Cooling water qty. : 3 lpm.

Pressure (max.) : 10 bar

Recommended temperature : 10 °C to 30 °C.

Cooling to Pedestal

In case of centre feet mounted CPK Pumps, cooling to pedestal is recommended for working temperature above 250 °C. The cooling can be arranged in parallel or in series with the bearing bracket.

Cooling water qty. :

In series with the bearing bracket (e.g. API Plan G) : 5 lpm.

In parallel with the bearing bracket (e.g. API plan G1) : 3 lpm

Pressure (max.) : 6 bar

Recommended temperature : 10°C to 30 °C

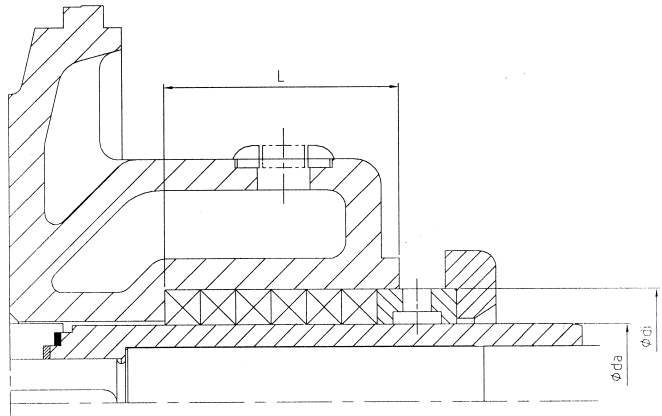
Heating

The space between casing cover and bearing bracket can also be used for heating by hot water, steam or any other suitable heat transfer media.

Maximum temperature : 183 °C

Maximum Pressure : 10 bar.

Stuffing box arrangement of CPK Y Pumps.



Bearing bracket	Dimensions of Packing compartment in mm.			Cross Section packing in mm.	Packing rings
	Ø da	Ø di	L		
P25/62	35	51	53	8 x 8	6 nos.
P35/80	45	65	64	10 x 10	
P45/120	55	75	64	10 x 10	
P55/140	70	95	79	12.5 x 12.5	
P65/160	80	105	-	12.5 x 12.5	

5.3 Spares

5.3.1 Ordering spare parts

Please quote the following information when ordering spares

Part Name :

Pump type : CPK in this case with appropriate size

Part No. :

Serial No. :

Works Order No. :

The above details are stamped on the name plate.

5.4 Interchangeability of pump components

Bearing bracket	Pump size	Designation	Part No.																				
			Casing Cover	Support foot	Shaft	Angular contact ball brg. (set)	Deep groove ball bearing	Cylindrical Roller bearing	Bearing bracket	Bearing bracket lantern	Mechanical seal	Stuffing box gland	Stuffing box pressure ring	Neck ring	Lantern ring	Stuffing box packing	Seal cover	Wearing ring	Splash ring	Shaft Protection sleeve	Drip plate	Impeller nut	
			161	183	210	320	321.1/2	322	330	344	433	452	456	457	458	461	471	502	507	524	648	922	
P25/62	32-125		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	32-160		2	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	
	40-160		2	2	1	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1	1	
	50-160		2	3	1	1	1	1	1	2	1	1	1	1	1	1	1	3	1	1	1	1	
	32-200		3	3	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1
	40-200		3	3	1	1	1	1	1	3	1	1	1	1	1	1	1	2	1	1	1	1	1
50-200		3	3	1	1	1	1	1	3	1	1	1	1	1	1	1	3	1	1	1	1	1	
P35/80	80-160		4	5	2	2	2	2	2	4	2	2	2	2	2	2	2	10	2	2	2	2	
	65-200		5	5	2	2	2	2	2	5	2	2	2	2	2	2	2	8	2	2	2	2	
	80-200		5	5	2	2	2	2	2	5	2	2	2	2	2	2	2	10	2	2	2	2	
	100-200		5	6	2	2	2	2	2	5	2	2	2	2	2	2	2	12	2	2	2	2	
	32-250		6	5	2	2	2	2	2	6	2	2	2	2	2	2	2	6	2	2	2	2	
	40-250		6	5	2	2	2	2	2	6	2	2	2	2	2	2	2	5	2	2	2	2	
	50-250		6	5	2	2	2	2	2	6	2	2	2	2	2	2	2	4	2	2	2	2	
	65-250		6	6	2	2	2	2	2	6	2	2	2	2	2	2	2	8	2	2	2	2	
	80-250		6	7	2	2	2	2	2	6	2	2	2	2	2	2	2	11	2	2	2	2	
	40-315		7	6	2	2	2	2	2	7	2	2	2	2	2	2	2	5	2	2	2	2	
50-315		7	7	2	2	2	2	2	7	2	2	2	2	2	2	2	7	2	2	2	2		
P45/120	100-250		8	8	3	3	3	3	3	6	3	3	3	3	3	3	3	13	3	3	2	3	
	125-250		8	9	3	3	3	3	3	6	3	3	3	3	3	3	3	15	3	3	2	3	
	150-250		8	10	3	3	3	3	3	6	3	3	3	3	3	3	3	16	3	3	2	3	
	65-315		9	8	3	3	3	3	3	7	3	3	3	3	3	3	3	9	3	3	2	3	
	80-315		9	9	3	3	3	3	3	7	3	3	3	3	3	3	3	12	3	3	2	3	
	100-315		9	9	3	3	3	3	3	7	3	3	3	3	3	3	3	14	3	3	2	3	
	125-315		9	10	3	3	3	3	3	7	3	3	3	3	3	3	3	16	3	3	2	3	
	80-400		10	10	3	3	3	3	3	8	3	3	3	3	3	3	3	12	3	3	2	3	
	100-400		10	10	3	3	3	3	3	8	3	3	3	3	3	3	3	14	3	3	2	3	
	125-400		10	11	3	3	3	3	3	8	3	3	3	3	3	3	3	15	3	3	2	3	
P55/140	200-250		11	13	4	4	4	4	4	9	4	4	4	4	4	4	4	17	4	4	3	4	
	150-315		12	12	4	4	4	4	4	10	4	4	4	4	4	4	4	18	4	4	3	4	
	200-315		12	13	4	4	4	4	4	10	4	4	4	4	4	4	4	19	4	4	3	4	
	250-315		12	16	5	4	4	4	4	10	4	4	4	4	4	4	4	21	4	4	3	4	
	150-400		13	12	4	4	4	4	4	11	4	4	4	4	4	4	4	18	4	4	3	4	
	200-400		13	13	4	4	4	4	4	11	4	4	4	4	4	4	4	20	4	4	3	4	
P65/160s	200-500		16	17	6	5		5	5	12		5	5	5	5		20	5	5	3	5		
	250-400		15	17	6	5		5	5	11		5	5	5	5		22	5	5	3	5		
	250-500		16	15	6	5		5	5	12		5	5	5	5		23	5	5	3	5		

Note : Part nos. 102 impeller & 230 Volute casing respectively cannot be used in other pump sizes.

5.5 Recommended stock of spare parts for 2 years of operation.

Part No.	Designation	Number of pumps (including stand by pumps)						
		2	3	4	5	6	8	10 and more
		No. of spare parts						
210	Shaft	1	1	2	2	2	3	30%
230	Impeller	1	1	2	2	2	3	30%
320	Angular contact ball bearings (set)	1	1	2	2	2	4	50%
321.01/02	Deep groov ball bearing	1	1	2	2	2	4	50%
322	Cylindrical roller bearing	1	1	2	2	3	4	30%
330	Bearing bracket	-	-	-	1	1	1	2 per 10 nos.
433	Mechanical seal	Refer works						
454	Stuffing box pressure ring	1	1	2	2	2	3	30%
456	Neck ring	1	1	2	2	2	3	30%
458	Lantern ring	1	1	2	2	2	3	30%
461	Stuffing box packing (set)	2	2	3	3	3	4	40%
502	Casing wear ring	2	2	2	3	3	4	50%
503	Impeller Wear ring	2	2	2	3	3	4	50%
524	Shaft protection sleeve	2	2	2	3	3	4	50%
	Gaskets (set) and O ring	4	6	8	8	9	12	150%

6. Faults

6.1 Faults, causes and suggested remedies.

Faults	Code Number Cause-remedy
Pump delivers insufficient liquid	1,2,3,4,5,6,7,8,9,10,11,18,28
Driver is overloaded	12,13,14,15,23,27,28
Excessively high pump discharge pressure	15
Excessively high bearing temperature	22,23,24,25,26
Leakage at the pump	29
Excessively leakage at shaft seal	17,18,19,20,21,22,23,33
The pump runs rough	3,6,11,12,22,23,30,31,32
Excessive temperature rise inside the pump	3,6,32

6.2 Cause-Remedy¹⁾

1. The pump delivers against an excessively high discharge pressure
 - open discharge valve further until the duty point conditions have been attained (adjusted)
2. Excessively high back pressure
 - fit an over size impeller²⁾
 - increase rotational speed (applies to turbine or I.C. engine driven pumps)
3. The pump and/or piping are incompletely vented or primed.
 - vent or prime the pump and system completely.
4. Suction line or impeller clogged.
 - Remove deposits in the pump and/or piping.
5. Formation of air pockets in piping.
 - Alter piping layout

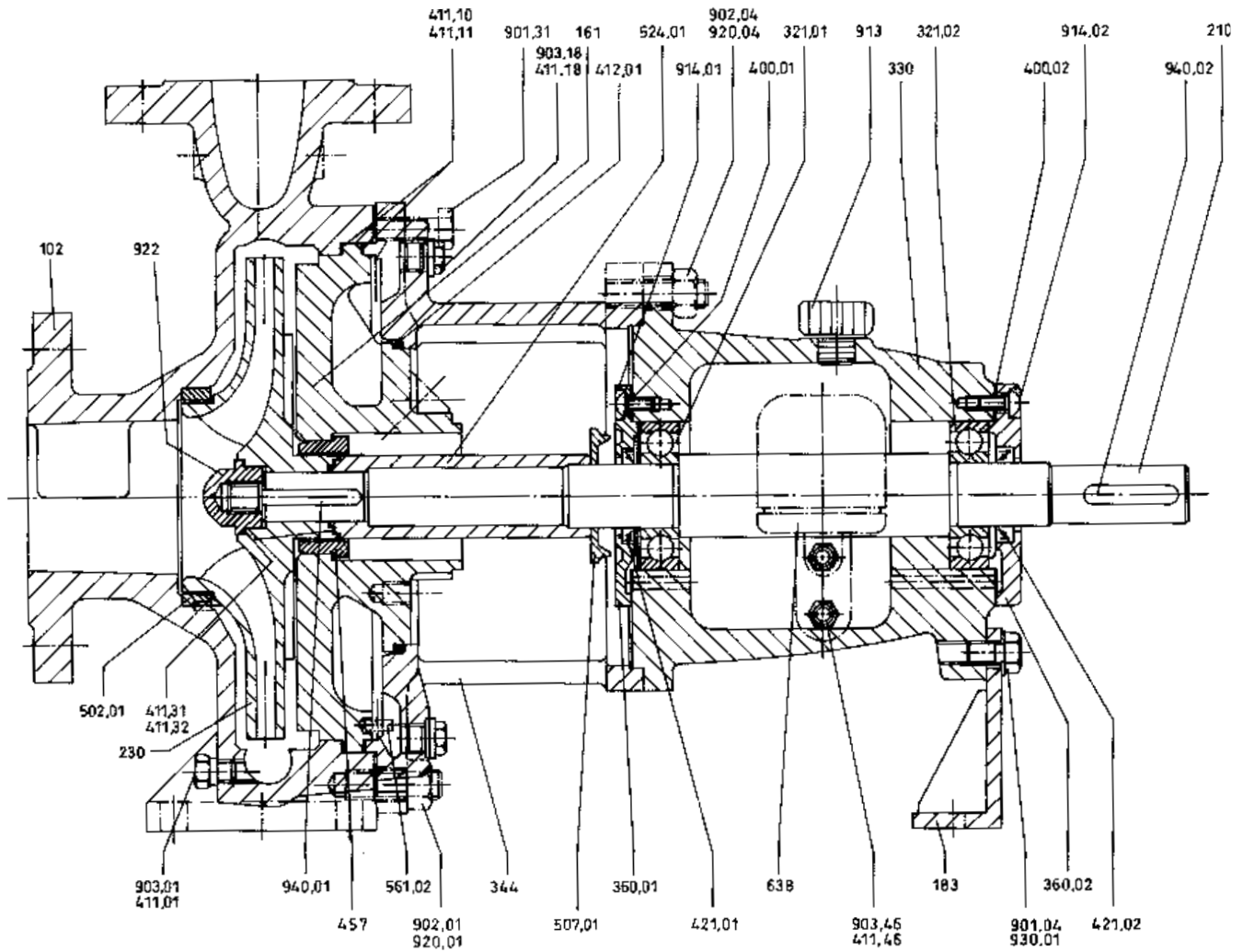
- If necessary fit a vent valve.
- 6. NPSH available is too low (on positive suction head installation)
 - Check liquid level in suction vessel.
 - Open isolating valve in suction line fully.
 - Install a different suction line if necessary, if the friction losses in the suction line are excessive.
 - Check the suction line strainer.
- 7. Excessively high suction lift
 - Clean out suction strainer basket and suction piping.
 - Check liquid level in the pit.
 - Alter the suction line.
- 8. Entrainment of air through the stuffing box.
 - Sealing liquid passages are clogged; clean them out if necessary, arrange a sealing liquid supply from an outside source, or increase sealing liquid pressure.
 - Fit a new shaft seal.
- 9. Reverse rotation.
 - Change over two of the phase leads of the power supply cable.
- 10. Rotational speed is too low^{2) 3)}
 - Increase rotational speed
 - Increase voltage of power supply
- 11. Excessive wear of the pump internals
 - Replace worn components by new ones.
- 12. 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 if necessary²⁾
- 13. Specific gravity or viscosity of the fluid pumped is higher than that specified in the purchase order²⁾
- 14. Stuffing box gland tightened excessively or askew
 - Adjust the gland as required.
- 15. Excessive rotational speed
 - Reduce speed (applies to turbine or I.C. engine driven pumps^{2) 3)}
- 16. Worn shaft seal
 - Check condition of shaft seal and renew it if necessary.
 - Check flushing liquid or sealing liquid pressure.
- 17. Grooving score marks or roughness on shaft protection sleeve surface.
 - Fit a new shaft protection sleeve
- 18. Lack of cooling liquid or fouled and clogged liquid compartment.
 - Increase the flow of cooling liquid
 - Clean out the cooling compartment
 - Clean the cooling liquid itself.
- 19. Stuffing box gland, and cover or seal cover incorrectly tightened, wrong type of packing material used.
 - Remedy the fault.
- 20. The pump runs rough
 - Correct the suction conditions
 - Check alignment of pumping set and realign if necessary
 - Re-balance the pump rotor dynamically
 - Increase the suction pressure at pump suction nozzle.
- 21. Pumping set misaligned
 - Check alignment at coupling and realign the set if necessary
- 22. The pump is warped
 - Check piping connections and pump fixing bolts.
- 23. Excessive axial thrust²⁾
 - Clean out balance holes in impeller
 - Fit new casing wear ring.
- 24. Too much or too little lubricant or unsuitable lubricant quality.
 - Top up lubricant, reduce quantity of lubricant or change lubricant quality.
- 25. The prescribed coupling gap has not been maintained
 - Restore correct coupling gap in accordance with the data on the foundation drawing.
- 26. Operating voltage is too low.
 - Rectify.
- 27. The motor is running on two phases only.
 - Replace the defective fuses.
 - Check the cable connections.
- 28. The connecting bolts are slack.
 - Tighten the bolts.
 - Fit new gaskets.
- 29. The rotor is out of balance
 - Clean the rotor
 - Re-balance the rotor dynamically
- 30. Defective bearings
 - Fit new bearings.
- 31. Insufficient rate of flow
 - Increase the minimum rate of flow.
- 32. Faults in the circulation liquid supply
 - Increase the cross section of the circulation liquid line.

1) The pump should be made pressurless before attempting to remedy faults concerning parts exposed to pressure

2) Please refer to KSB

3) This fault can be also be remedied by altering the impeller diameter.

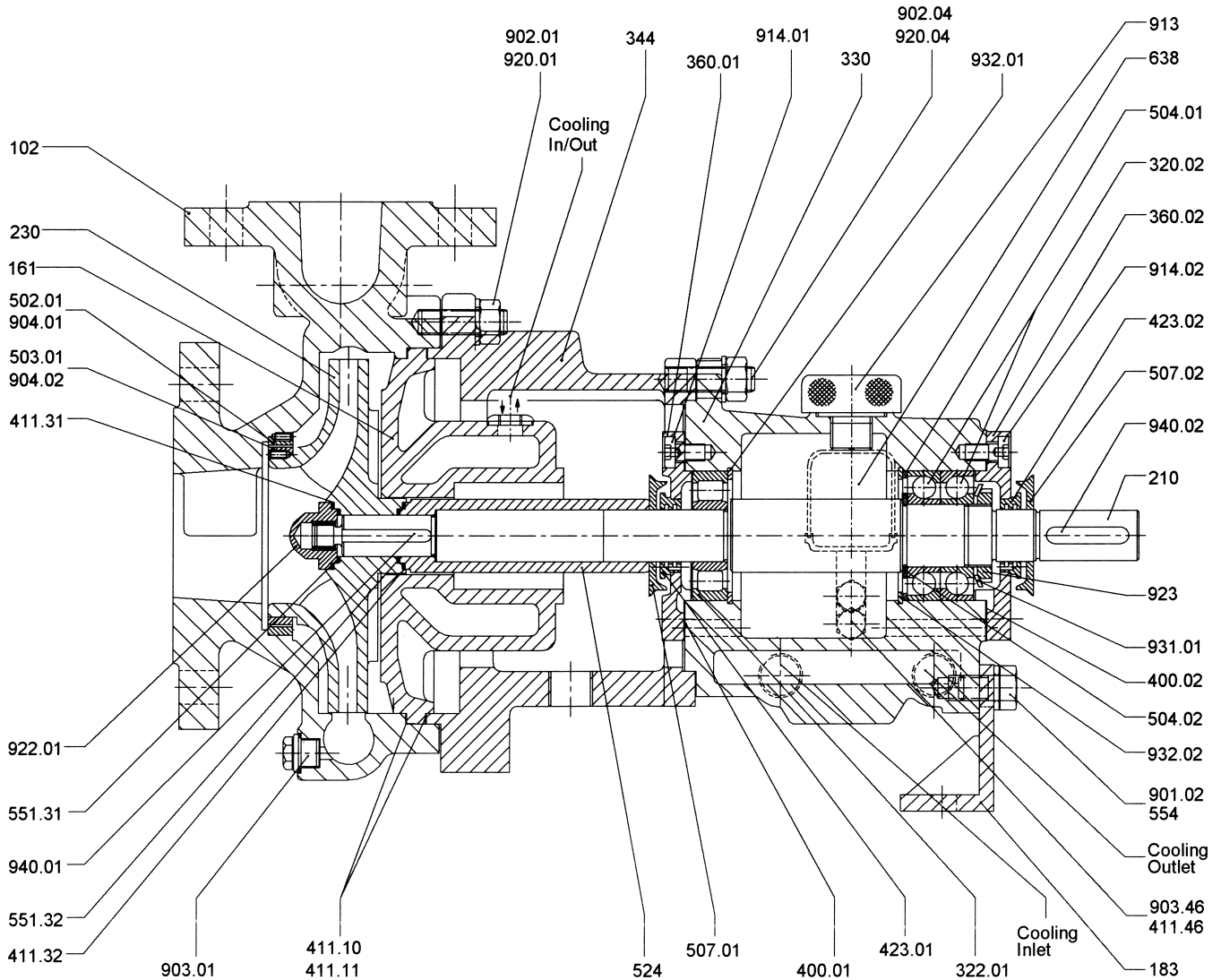
7. Cross Sectional Drawing & Part List



Part No.	Description	Part No.	Description
102	Volute casing	503.01	Wearing ring impeller
161	Casing cover	507.01	Splash ring
183	Support foot	524	Shaft protection sleeve
210	Shaft	551.31/32	Washer
230	Impeller	554	Spring washer
321.01/02	Deep groove ball bearings	562.02	Cylindrical pin
330	Bearing bracket	638	Constant level oiler
344	Bearing bracket lantern	901.02	Hex. bolt
360.01/02	Bearing covers	901.31	Hex. bolt
400.01/02	Flat gasket	902.01/04	Stud
411.10/11	Flat gasket - hex. head plug	903.01/46	Hex. head plug
411.31/32	Flat gasket - impeller nut / impeller	913	Vent plug
411.46	Flat gasket - drain plug	914.01/02	Allen head screw
412.01	O ring	916.18	Allen head plug
421.01/02	Oil seals	920.01/04	Hex. head nut
457	Neck ring	922.01	Impeller nut
502.01	Wearing ring - casing	940.01/02	Key

7.1 Cross sectional drawing of CPK Y Pumps.

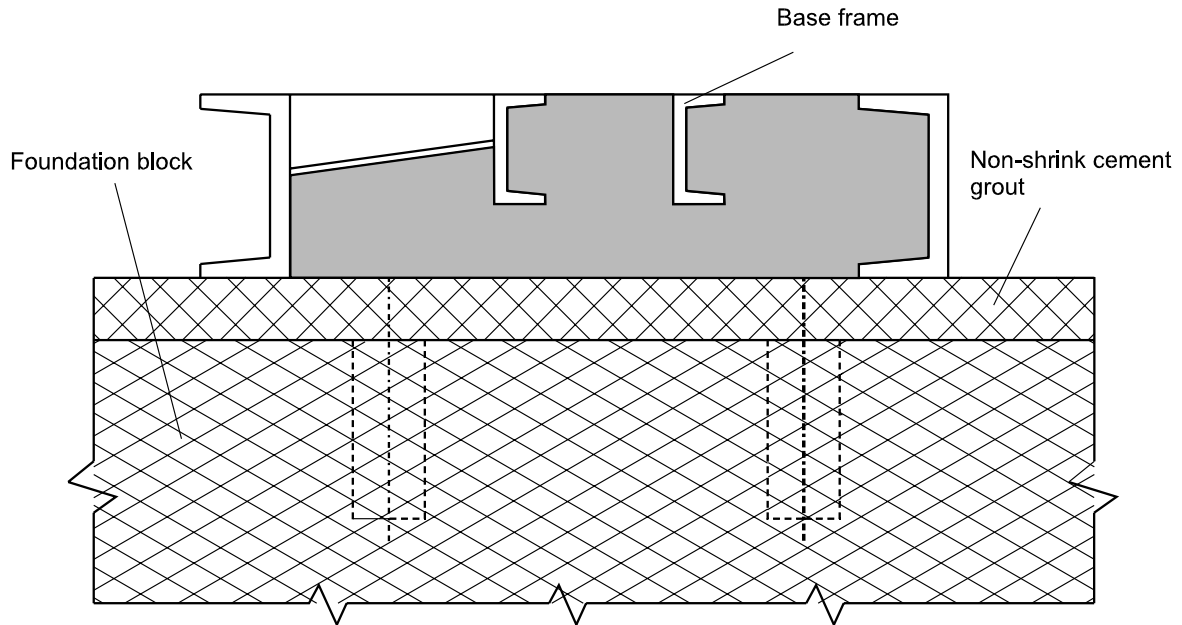
Typical arrangement showing CPK Y Pump with heavy bearing bracket. In case you need more details about the pump available with you; please contact our Authorised Dealer or KSB office.



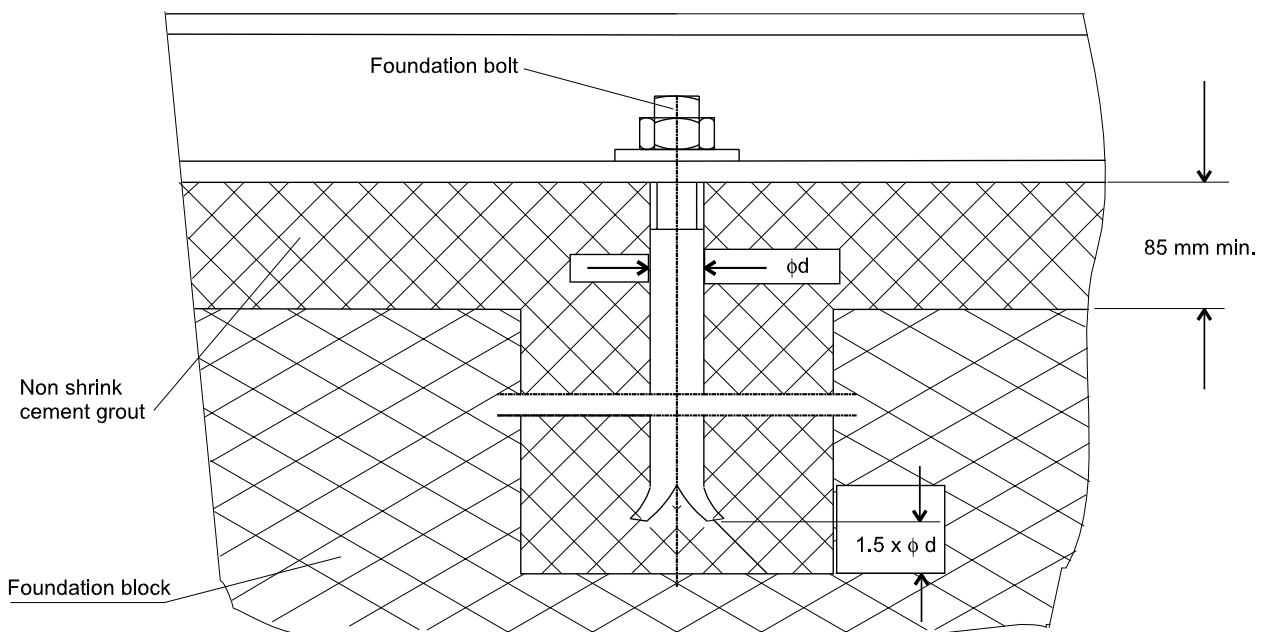
Part no.	Description	Part no.	Description
102	Volute casing	183	Support foot
502.01	Wearing ring - Casing	901.02	Hex. Hd. Bolt - Support foot
904.01	Allen grub plug - Casing wearing ring	554	Spring Washer - Support foot
903.01	Hex. Hd. Plug - Casing drain	330	Bearing bracket
902.01 / 920.01	Stud / Hex. Nut - volute casing	322.01	Cylindrical roller bearing
411.10	Gasket - Volute casing	320.02	Angular contact bearing
161	Casing Cover	932.01 / 932.02	Circlip
411.11	Gasket - Casing cover	504.01 / 504.02	Adjusting Disc
230	Impeller	931.01	Lock Washer
503.01	Impeller Ring	923	Withdrawl nut
904.02	Allen grub plug - Impeller ring	400.01 / 400.02	Gasket - Bearing cover
922.01	Impeller nut	360.01 / 360.02	Bearing cover
551.31 / 551.32	Washer - Impeller	914.01 / 914.02	Socket Hd. Cap Screw - Bearing cover
411.31 / 411.32	Gasket - Impeller	423.01 / 423.02	Labyrinth ring
210	Shaft	507.01 / 507.02	Splash ring
940.01 / 940.02	Key	913	Vent plug
524	Shaft protection sleeve	638	Constant lever oiler
344	Bearing bracket lantern	903.46 / 411.46	Hex. Hd. Plug / Gasket - oil drain
902.04 / 920.04	Stud / Hex. Nut - Brg. Bkt / Brg. Bkt. Lantern		

Annexure I : Arrangement For Base frame Grouting

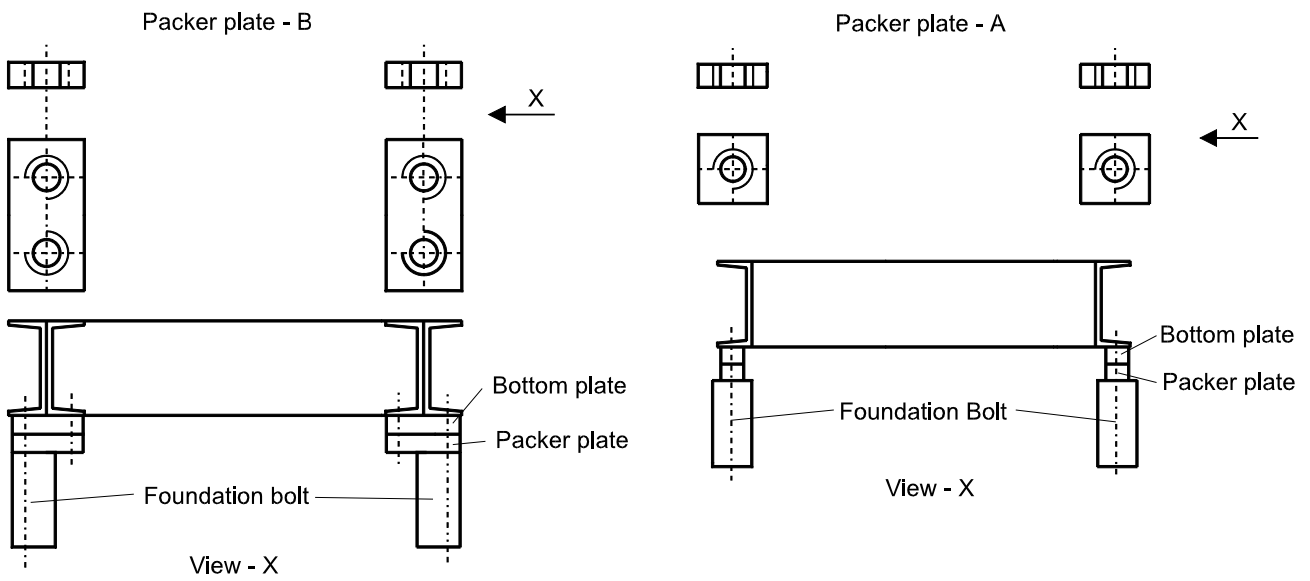
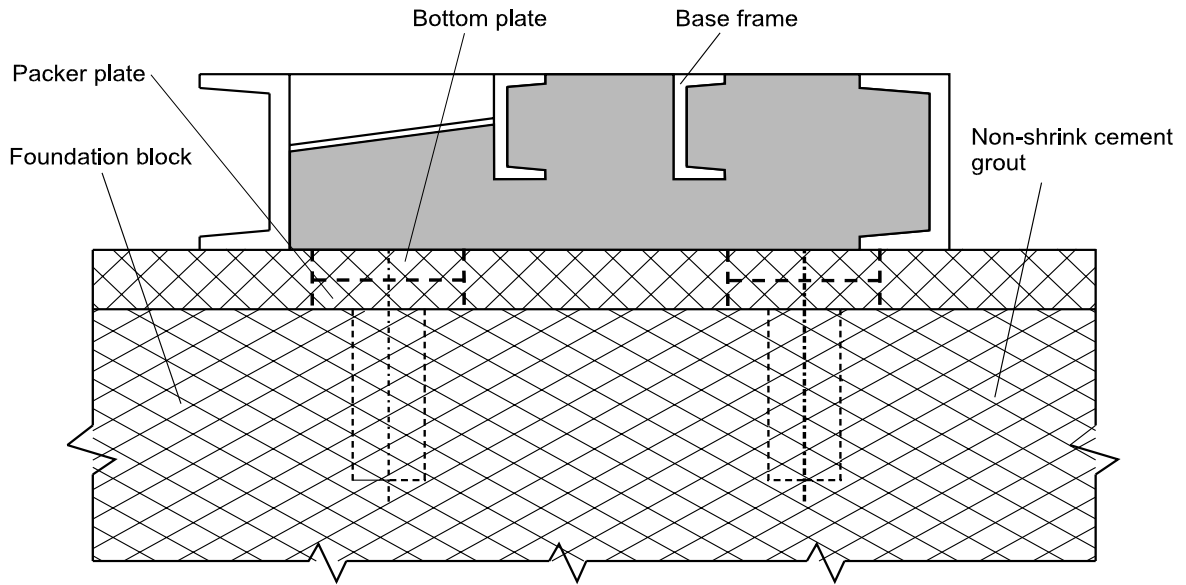
A. Grouting details for base frame without Packer plates.



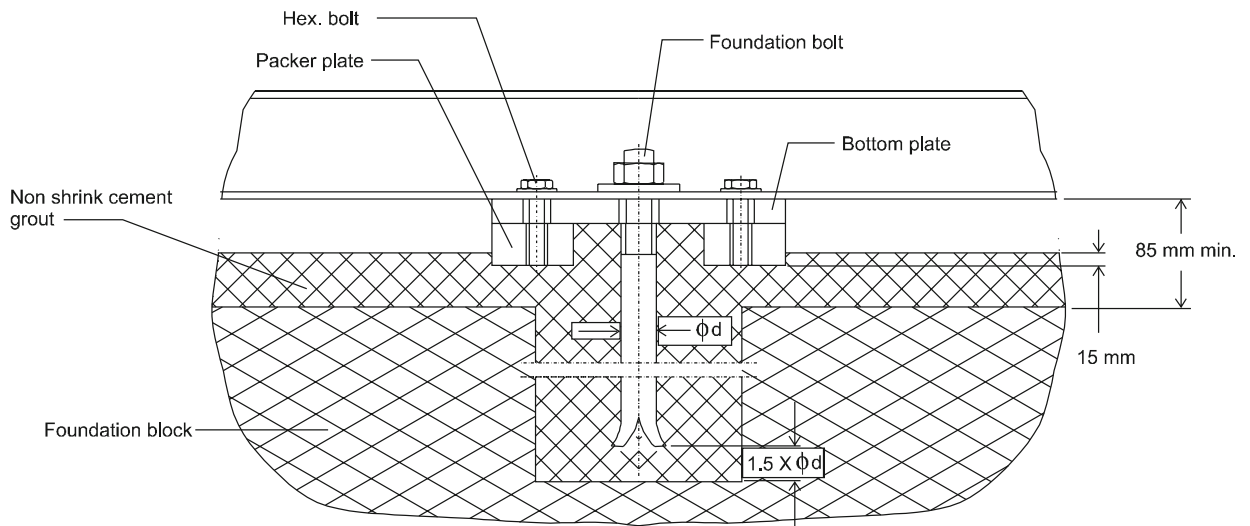
B. Grouting details for foundation bolts.



C. Grouting details for base frame with Packer plates.



D. Grouting details for foundation bolts



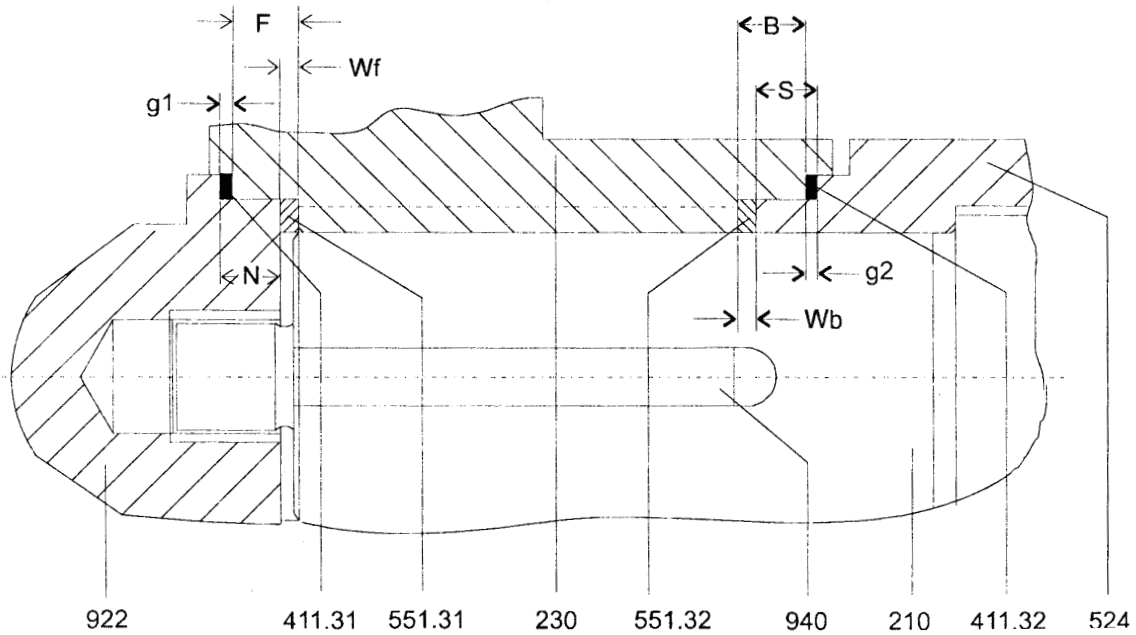
Annexure II : Metallic washer fitment for impeller, impeller nut and shaft protection sleeve (wherever applicable)

Metal to metal fit of impeller nut (922), impeller (230) and shaft protection sleeve (524) against the shaft shoulder is done as shown in the sketch and as described in the procedure given below :

This is achieved without reworking of standard parts. However recheck cavity dimensions as shown below and rework only if required.

Procedure

Spacer washer (551.32) and gasket (411.32) are inserted between shaft protection sleeve (524) and impeller (230). Then the spacer washer (551.31) and gasket (411.31) are placed between the impeller (230) and impeller nut (922) and finally impeller nut (922) is tightened.



To calculate g1 & g2 use following formula

1. $g1 + F = N + Wf$
2. $g2 + B = S + Wb$

Where wf : front washer thickness
 wb : back washer thickness
 g1 : front gasket cavity thickness
 g2 : back gasket cavity thickness
 F : Impeller front length
 B : Impeller back length
 S : Sleeve length

Part No.	Part Name
210	Shaft
230	Impeller
411.31/32	Graphite gaskets
524	Shaft protection sleeve
551.31/32	Spacer washers
922	Impeller nut
940	Key

Note :

1. When bearing brackets P 55/140s & above; are used, check if the washer 551.31 rests on the supporting face of the impeller. If not, rework length of the key.
2. For bearing brackets P 55/140s & above; part no. 551.32 will be in two halves.

Annexure III : Wearing Ring Clearances in mm.

Bearing Bracket	Washer thickness (mm)		Gasket thickness (mm)	
	551.31	551.32	411.31	411.32
P 25/62	1.1	1	1.5	1.5
P 35/80s	2.1	1	1.5	1.5
P 45/120s	2.1	1	1.5	1.5
P 55/140s	2.1	1	1.5	1.5
P 65/160s	3.1	1	1.5	1.5
P 80/200s	5	1	1.5	1.5

Pump size	Group 1	Group 3*
up to DN 65	0.4 +0.1	0.6 +0.1
DN 80-150	0.5 +0.1	0.65 +0.1
DN 250 & above	0.65 +0.15	0.75 +0.15
DN 200	0.55 +0.1	0.65 +0.15

The clearances are identical on the suction & discharge side.

* For all CPK C pumps and for CPK E pumps with temperature > 280°C.