Enriching Lives

Instructions on Installation, Operation & Maintenance for Kirloskar Pump Type – Large Vertical Turbine Pump - BHR/BHQ/BHM/BHK/BHMa/BHA

KIRLOSKAR BROTHERS LIMITED
Established 1888
A Kirloskar Group Company

KIRLOSKAR BROTHERS LIMITED

REGD. OFFICE : UDYOG BHAVAN, TILAK ROAD, PUNE 411 002 (INDIA)

WARRANTY

We warrant that the pump supplied by us is free from defective material and faulty workmanship. This warranty holds good for a period of 12 months from the date of commissioning the equipment or 18 months from the date of despatch from our factory, whichever is earlier. Our liability in respect of any complaint is limited to replacing part/parts only to the extent that such replacement/repairs are attributable to or arise solely from faulty workmanship or defective material.

This warranty holds good only for the products manufactured by us.

—KIRLOSKAR BROTHERS LIMITED

INSTRUCTIONS FOR ERECTION, OPERATION & MAINTENANCE OF KIRLOSKAR VERTICAL TURBINE PUMPS

I. INTRODUCTION :

These vertical turbine pumps are manufactured to close tolerances and rigid specifications. Hence proper erection and maintenance is equally important to ensure trouble-free service.

This manual covers important guidelines and instructions on erection, operation and maintenance. These instructions should be followed carefully, failing which may result in the unsatisfactory performance/damage to the pump.

Only mechanical aspects are dealt in this manual. Civil and electrical engineering details are to be finalized by clients.

Any special problems arising at site should be referred to the supplier/KIRLOSKAR BROTHERS LIMITED, UDYOG BHAVAN, TILAK ROAD, PUNE (INDIA).

WHILE referring the problem, the name-plate details of the pump should invariably be mentioned in the correspondence.

This manual covers instructions for pump types BHR, BHQ, BHM & BHMa with following constructional features :

1. Self Water lubricated pumps.
2. External forced water lubricated pumps.
3. Oil lubricated pumps.
4. Delivery below ground level.
5. Delivery above ground level.
6. Grease lubricated, anti-friction thrust bearing.
7. Oil lubricated mitchel type thrust bearing.
8. Solid shaft motor drive.
9. Hollow shaft motor drive/Gear drive.

II. PRE-REQUISITES FOR SATISFACTORY WORKING :

REMEMBER

For satisfactory operation, the pump must work under specific conditions given below :

a) The pump handles the liquid as specifid in the order.

b) The pump operates at the duty point specified in the order.

c) Minimum submergence is kept as shown in the outline dimension drawing supplied against the order.

d) Operating & Maintenance instructions are followed as given in this manual.

e) Load of delivery pipe and other accessories such as Sluice Valve, Reflux Valve do not come directly on pump delivery flange.

f) The erection is carried out by experienced skilled personnel.

Prior confirmation must be taken from the manufacturer/supplier, if the pump is to be used for the condition other than specified in the order.

III. PUMP HOUSE LAYOUT :

The layout of pumping station involves considerations of :

1. WATER INLET TO THE SUMP :

The water inlet to the sump is to be designed and located as to make provisions to avoid —

1.1 Turbulence

1.2 High velocity

1.3 Silt deposition

1.4 Air entrainment

1.5 Difference between the levels of inlet source and sump water.

2. SUCTION SUMP :

The sump should be so designed as to provide :

2.1 Enough water storage capacity to avoid.

2.1.1 Sudden fluctuations in water levels.

2.1.2 Kinematic distrubances at the bell mouth such as turbulence, eddies, vortices, etc.

2.1.3 Air entrainment.

2.2 Low water velocity

The maximum water velocity in sump should not exceed one metre per second in any case Normally this is achieved by—

2.2.1 Drawing the water from the source in the direction opposite to that of the source of flow.

2.2.2 Looping the flow drawn.

2.2.3 Baffling the flow passages.

2.2.4 Avoiding difference in the levels of source of water and sump water. For this, the intake pipes or channels of enough cross-sectional area are to be provided.

2.3 Minimum or no silt deposition.

As far as possible silt deposition should not be permitted in the sump. However, where deposition is unavoidable the maximum deposition level should be maintained at least one diameter length below the end of the Bell mouth (In the case of strainer, it is always below the lower end of the strainer).

In case liquid containing silt is handled by pump, then it will cause extensive damage to pump parts.

2.4 Individual flow pattern

Where one sump is having more than one pumpset, every pump should have its individual flow pattern undisturbed by the others. While locating the pump in the sump, minimum distances from walls, floor and adjacent pipes as recommended by International Standards should be maintained.

2.5 Pump Submergence

The lowest water level in the sump should keep the lowest bowl submerged in order to avoid air entering the Bell Mouth & forming vortices. However, submergence depends upon the pump capacity. The minimum submergence to be kept is shown in the outline drawing supplied against the order. The maximum level in the sump should be lower than the pump floor level i.e. during the floods.

3. PUMP HOUSE REQUIREMENTS :

These cover mainly the following aspects.

3.1 Strength of the building.

3.2 Sufficient floor area for working and overhauling.

3.3 Sufficient head room for erection.

3.4 Ventilation.

3.5 Provision for store-room.

IV STORAGE AND HANDLING :

A. ON RECEIVING THE MATERIAL

(TO AVOID DAMAGES DURING TRANSIT, THE PUMP IS SUPPLIED IN PARTIALLY ASEMBLED CONDITION.)

1. CHECK that all the packages are intact and that open parts are not damaged in transit.

2. OPEN the packings & check contents of each packing against delivery note, packing slip.

3. CHECK specifically line shafts and verify that these are not bent and are in good condition.

4. REPORT immediately discrepancies, if any, to the supplier.

5. UNLESS the pump is to be installed immediately, repack the material in respective cases after the contents have been verified.

6. DO not open the packages again unless ready for erection.

B. STORAGE

1. Storing place should be adequately clean. Store-room should have sufficient space for easy movement and stacking of material. The floor of the store room should be hard and plain.

2. Do not place the packages one over the other inconveniently. Keep the parts on wooden logs and properly levelled.

3. Keep the parts in proper sequence so that during erection they can be taken out in an orderly fashion.

C. HANDLING

1. All machined parts are coated with a special antirust coat. If any part is found exposed, clean it and apply a thick coating of grease or anti-rust compound and then wrap it with wax paper to prevent further rusting.

2. Never try to drag any part or packages of parts for any reason. Dragging sets in intrinsic vibration which distorts the accuracies, parallelism etc. of machined surfaces. Distortion of accuracies might cause serious functional and operation troubles.

3. Over-hanging should be avoided as far as possible. While lifting the parts by the ropes, they should be properly balanced.

4. Transportation should be free from jerks, long parts should not be handled without due supports.

5. Open parts must be transported on soft and well supported bedding to prevent scratches.

CAUTION

Care must be exercised in handling of all parts, particularly the shafts, column pipes and shaft enclosing tubes. They are machined to close tolerances and carefully inspected at factory and if bent, can cause trouble. A bent shaft or pipe should never be installed in the well.

V EQUIPMENT AND TOOLS :

1. OVERHEAD CRANE/CHAIN PULLEY BLOCK :

   The Crane/chain pulley block should be of ample capacity to take the load of the complete unit. There should be a minimum clear height between foundation & top most position of pulley block as indicated on outline drawing supplied against the order to facilitate easy erection. The pulley block should have the lift of 5-6 metres and the hand chains provided should be long enough to operate it conveniently from the floor.

2. Chains & lifting hooks, shackles.

3. Jute ropes, crow bars and small pipes for leverage.

4. Light but accurate straight edge.

5. Spirit level having the accuracy of 0.02 mm/metre.

6. Kerosene and thinner for cleaning of parts.

7. Threading compound to prevent rusting.

8. Feeler gauge and shims for adjustment of level.

9. 'V' Blocks and dial gauge with magnetic stand to check the trueness of the shaft etc.

10. Small wire brush for cleaning of threads of shaft and coupling.

11. Lubricating oil required during erection (for oil lubricated pumps).

12. Anti-galling lubricant such as "Molykote."

13. Special spanners and clamps required for erection are generally supplied by us as under, against specific order and depending upon type of pump supplied.

    a) 2 pairs of clamps for column pipes.

    b) One pair of clamps for shaft enclosing tubes.

    c) One eye bolt for Head shafts.

    d) One set of clamp for Line shafts.

    e) One spanner for impeller nut.

    f) One spanner for threaded barrel coupling.

    g) One spanner for Line shaft.

    h) One pair of spanner for nuts of thrust collar.

    i) One spanner for coupling bolts.

    j) One pair of lifting hooks for journal bearing/thrust collar.

Besides above, the erector must have following standard tools and equipment for smooth erection :

i. Files-triangular, half round & flat.

ii. Trangular scraper.

iii. Two sets of standard or ring spanners.

iv. Set of pipe wrenches & chain tangs.

v. Adjustable spanner, screw drivers of 300 mm (12") and 150 mm (6").

vi. Steel rule, steel tape.

viii. Set of taps and dies upto 25 mm (1").

ix. Chisel, machinists hammer, hacksaw, vice etc.

x. Emery paper, grease gun, thin rolled sheets of brass 0.03 to 0.05 mm thickness for cutting shims.

VI. FOUNDATION :

THE FOUNDATION LAYOUT & DESIGN SHOULD BE CONSIDERED FROM THE FOLLOWING ASPECTS :

1. DIMENSIONAL REQUIREMENTS :

1.1 The location and grounting of the foundation bolts should be marked out as per the foundation drawing which is supplied in advance. For pumps mounted on girders, the foundation bolt holes should come on beam centre.

1.2 The foundation opening should be large enough so that the Bell mouth and outlet 'T' will pass easily through the bore.

2. STRENGTH OF FOUNDATION :

2.1 The foundation should be sufficiently strong to take load of pump, motor etc., to absorb any vibration and to form a permanent rigid support (The weight of the pump is given in G.A. drawing).

The total load is borne by foundation plate/base plate. In order to take this load (including safety factor for vibration) the foundation plate should be firmly grounted in the concrete. If possible, foundation plate should be welded to the reinforcement of the concrete. Foundation plates should not get loose or form pockets with the parent foundation.

3. LEVELLING THE FOUNDATION :

The guidelines about grounting and levelling of foundation plates are as under —

BEFORE POURING THE CONCRETE

3.1 It is essential to check the level of the foundation plates individually and in combination.

3.2 The top surface of the foundation plates should be levelled to the accuracy of 0.05 mm/m. All foundation plates should be kept in position. Then one foundation plate should be adjusted for height levelled by putting shims below it. Other foundation plates should be levelled with respect to this foundation plate with the help of straight edge and spirit level.

The straight edge used for checking the level should be long enough to cover the entire cross length of the foundation plates and it should not rest anywhere but on the machined surface of the foundation plates.

After pouring the concrete

3.3 Before allowing the concrete to set, check the level of foundation plates individually and in combination as there is a possibility of distortion while pouring the concrete.

3.4 After setting of the concrete, recheck the levels on the surfaces of foundation plates. Bring the sole plates in level to the accuracy of 0.05 mm/m by grinding or scraping if the distortion is taken place due to setting.

3.5 For the pumps mounted on girders, similar checks about individual and in combination level to be made before and after welding of the foundation plates to the girders.

(IF THE FOUNDATION PLATES ARE PROCURED BY THE CLIENTS DIRECTLY AT THEIR END THEN ENSURE THAT FOUNDATION PLATES ARE MACHINED TO CLOSE TOLERANCE).

4. DISTURBANCES TO THE LEVELLING :

4.1 Due to resetting :

After the installation is completed, and the operation is commenced, it is likely that the concrete foundation and concrete supports suffers deformations due to resetting. This can happen due to the internal stresses in the concrete which get relieved with time and due to operating conditions. Hence a frequent check is needed on the level of the foundation plates on which the entire pump assembly is mounted and the alignment of the delivery pipe line and delivery 'T' are not disturbed. During the readjustment of level or alignment of delivery flanges, use of shims may be necessary. In such cases; surface contact between the foundation plates, shims, and lower motor stool should be ensured.

4.2 Connecting to the delivery pipe line :

After mounting the lower motor stool on the foundation plates, delivery pipe flanges should perfectly match with the flange of the outlet pipe. In case the alignment is imperfect, it is bound to distrub the alingment of the pump. Clearance between the flanges should be such that it does not give rise to any horizontal displacement of the pumping unit during tightening them together alongwith the intermediate packing. For checking the alingment of delivery flanges it will be convenient to use the sub-assembly of the lower motor stool and intermediate pipes upto outlet 'T'. Due care should be taken to see that load of the delivery piping and accessories such as sluicevalve, reflux valve etc., is not coming on the pump flange. Separate firm supports should be given to the delivery pipe and its accessories.

VII. PREPARATION FOR ERECTION :

CLEAING OF PARTS :

During transit and storage of equipment, after it has reached destination, considerable dust and foreign material may have lodged on the various parts of the pump. After the equipment has been taken to site, and just before erection all parts must be cleaned with great care. Some of the precautions that must be observed are as follows :

GENERAL : All the machined surfaces should be cleaned with kerosene/thinner to remove the antirust coat applied.

A) Pump Unit Assembly :

Flush the rotating assembly with water.

Rotate the Impeller shaft by hand to see that impellers are free and rotating freely. Pull the shaft and press it back again. The shaft should move freely if there is no damage or dislocation in the bowls.

Oil lubricated pumps are having bottom bearing enclosed in bell mouth filled with grease. If pumps is stored for more than one year then replace the grease. For grease specification refer technical data.

If the bowl assembly is not sent in assembled condition, remove the anti-rust coat from machined surfaces of pump unit components.

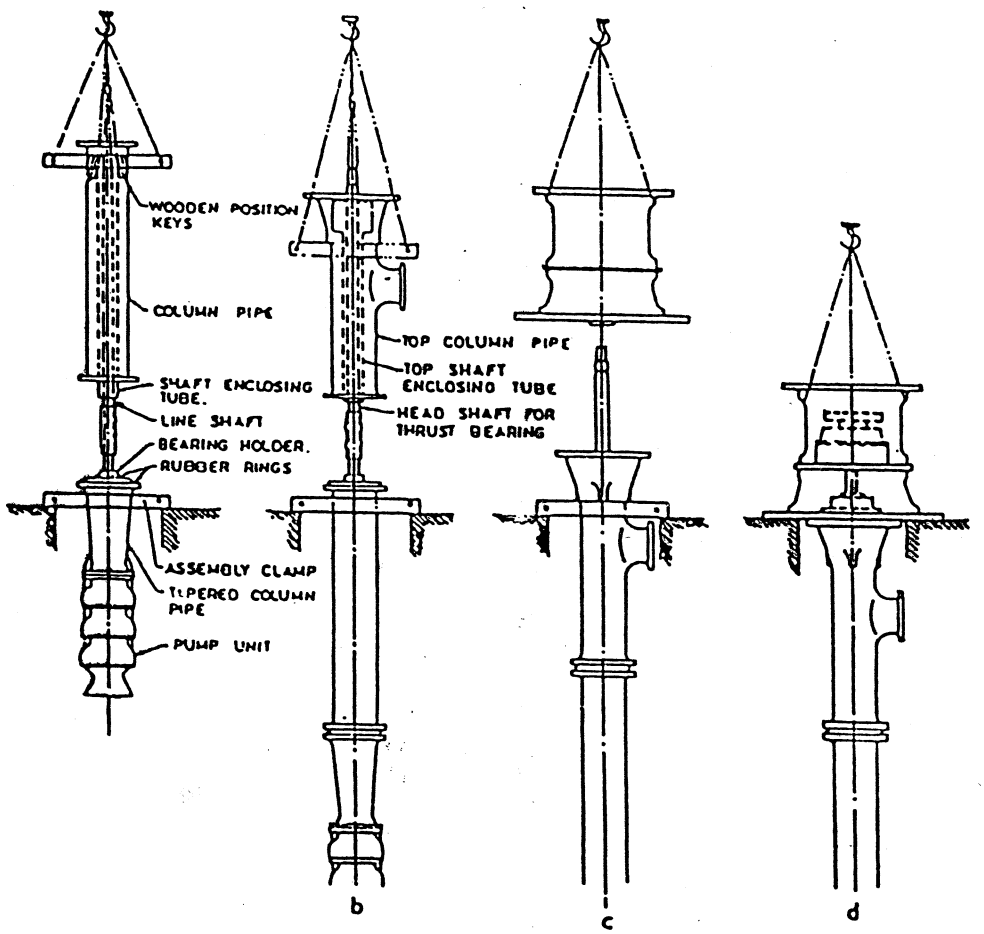

WOODEN POSITION KEYS
COLUMN PIPE
SHAFT ENCLOSING TUBE.
LINE SHAFT
BEARING HOLDER.
RUBBER RINGS
ASSEMBLY CLAMP
TAPERED COLUMN PIPE
PUMP UNIT
TOP COLUMN PIPE
TOP SHAFT ENCLOSING TUBE
HEAD SHAFT FOR THRUST BEARING
b
c
d

Fig - 1

10 (A)

B) Column Unit :

1. Shafts :

   The threads of shafts and couplings should be cleaned with kerosene/thinner using a wire brush or old tooth brush.

2. Shaft Enclosing Pipes :

   Clean the shaft enclosing pipes from inside with the help of long stick wound with cloth.

3. Rubber Bearings :

   The rubber bearings are to be cleaned with clear cold water. In any case, these rubber bearings should not come in contact with oil, grease or paint.

4. Metallic Bearings :

   The machined surfaces should be cleaned to remove anti rust coat. The oil grooves should be free from dirt & metal particles.

C) Head Unit :

(a) Motor Stool :

Clean the discharge head/lower motor stool removing all dirt, especially around the water way section.

(b) Thrust Bearing Housing :

Thrust bearing housing to be cleaned thoroughly. Thrust bearing housing and bearing parts should be absolutely free from dust particles, hence these are to be covered suitably till they are actually used in the accembly.

(c) Cooling coil/other pipe connections for the pump; with mitchel thrust bearing :

Cooling coil should be checked with water conection for leakage and blockage. Other pipe connections also should be flushed and checked for leakage etc.

NOTE :

ALL THE BURRS AND SHARP EDGES FOR MACHINED SURFACES SHOULD BE REMOVED WITH THE SCRAPER OR SMOOTH FILE.

CHECKING :

Though all the parts are duly packed while despatching from works, there is a possibility of bending of shaft and damage to the threaded and machined portions during transit. Hence following checks should be made.

1. Threaded portions of shafts and couplings are not damaged.

2. Threaded barrel coupling fits properly on the shaft. Coupling is not too tight or too loose on the shaft.

3. All the shafts to be checked for runout with the help of 'V' blocks and dial gauge or preferably on centre lathe, if available. The shaft runout should not exceed 0.2 mm at all portions.

Care to be taken during erection :

1. While assembly, do not apply undue force.

2. Avoid use of hammer.

3. Ensure perfect matching of contact surfaces.

4. Each and every part should be free from high points, burrs, dust etc.

5. Take care that no part is left out through oversight. Every single item, however small, has an Important role in the proper functioning of the pump.

6. Take care that no foreign substance is dropped or left inside. It will get stuck up and cause Jamming.

7. While fitting the rubber rings, care should be taken not to twist them or stress the joints. The rings prevent hydraulic leakage and hence their non-twisting is important. (Following method of fitting of rubber ring is convenient. Hold one side of the joint in the hand and insert the opposite portion of the ring in the groove. Apply light tension along the ring by a gentle pull by fingers and place it in a position of groove all around the periphery of the groove. The joint in the hand shall go in the position last.)

8. All tools and equipment should be kept ready before starting the erection.

(CROSS SECTIONAL DRAWING AND ERECTION INSTRUCTIONS SHOULD BE REFERRED TO DURING ERECTION).

9. Erection should be done by specialized experienced personnel.

VIII. ERECTION PROCEDURE FOR PUMP UNIT

(COMMON TO OIL/EXTERNAL AND SELF WATER LUBRICATION).

(Please refer to illustrations & Cross Sectional Drawings given on page 20 & onwards)

PUMP UNIT ASSEMBLY :

The pump unit is sent duly assembled from Works and includes bell mouth, Impellers, Pump bowl, Impeller shaft, Taper pipe/Discharge case, bearing holder for Impeller shaft, Impeller shaft enclosing tube, and cover for Impeller shaft etc.

Remove the cover for Impeller shaft. Put the clamps on bearing housing with stuffing box and lift the complete unit. Connect the suction strainer (If supplied) to bell mouth and then insert the subassembly in sump till the clamps rest on the foundation.

NOTE : Keep two wooden sleeper's or 'I' beams strong enough to support the weight of entire pump safely across the opening of pump floor.

B) Column Unit Assembly for Oil Lubricated Pump :

1. Column pipe, line shaft enclosing tube and line shaft should be suspended by clamp. Separate clamps are to be fixed to the rising pipe, protection pipe and line

shaft. These are to be suspended in such a way that shaft enclosing tube protrudes out of the column pipe and line shaft protrudes out of the shaft enclosing tube (See Fig. 1-a and 1-b).

2. Fit the shaft coupling on impeller shaft. While fitting the screwed coupling, proceed as follows :

   (a) Use thread compound (Molykote or graphited fine power mixed with grease or Oil) for preventing rust or seizing.

   (b) Half the coupling length should come on each shaft.

   (c) Coupling should be completely free from dust particles.

   (d) Rotate coupling 2/3 times till it fits smoothly on shaft.

   (e) Connect the line shaft to the shaft coupling. Tighten them till the line shaft is tightly butted against the impeller shaft in the shaft coupling.

While fitting the muff coupling, proceed as follows :

Fit distance sleeve under muff coupling (if supplied). Connect the intermediate shaft to the impeller shaft by means of muff coupling. The barell should first be slided on the intermediate shaft. Put the keys on both ends of the shafts and bring both shaft ends close together in line. With slight adjustments of shaft fit split rings on both ends of the shafts and slide the muff coupling on the impeller shaft till it rests on distance sleeve. Ensure proper fitting of the muff coupling with both the shafts and tight the grub screws provided on muff coupling.

3. Lower the shaft enclosing tube and screw it over the bearing holder. Tighten the shaft enclosing tube by suitable pipe wrench/chain tonges.

4. Lower the column pipe and connect it to the bottom column pipe. Tighten dimetrically opposite bolts evenly.

5. Remove the clamps fixed to the bottom column pipe.

6. Lower the complete unit till it rests on the clamps.

7. Pour 1/4 litre of lubricating oil for pre-lubrication of oil lubricated bearings.

8. Screw the bearing holder on the shaft enclosing tube.

9. The same procedure should be followed by installing stabilizing spider over enclosing tube using scapy water as lubricant at equal intervals of 10 meters approx. until all column pipes, column pipe with outlet 'T' (for below ground level delivery) are fitted. Approximately 1/4 litre of lubricating oil should be poured per bearing holder for pre-lubrication (See Fig. 1-c)

10. As prescribed above, fit the head shaft, head shaft enclosing tube and top column pipe.

11. Pour a litre of lubricating oil in head shaft enclosing tube for pre-lubrication.

12. Fix the rubber ring on top column pipe. Suspend the discharge head/motor stool (See Fig. 1-d). Fit the Discharge Head/motor stool to the top column pipe, in such

a way that the outlet position must coincide with delivery pipe line and foundation bolts match correctly with stool bolts.

13. Remove the clamp fixed to the top column pipe and lower the complete unit till Discharge Head/motor stool rests on foundation plates.

14. Level the Discharge Head/motor stool by means of a sensitive spirit level which should be placed on the machined surface of motor stool. Check the level in two directions at right angles to one another. Adjust the level by means of metallic shims. Tighten the foundation bolts. The level on the Discharge Head/motor stool should be within 0.05 mm/metre.

15. TUBE TENSION ARRANGEMENT :

    Perfect alignment of the intermediate shaft is achieved by the careful adjustment of tube tensioning device. Put the 'O' ring for cartridge and fit cartridge for tube tension nut on discharge head/motor stool. Insert 'O' ring for cartridge and adaptor sleeve around the portion of head shaft enclosing tube in the cartridge for tube tension nut and fit the adaptor sleeve for sealing.

    Apply PTFE tape on threads of tube tension nut and screw it in head shaft enclosing tube till it is flush with the face of cartridge for tube tension nut. Tighten it sufficiently by means of special spanner provided. The tightening will pull up the shaft enclosing tube putting them in tension. Avoid excessive tightening else the threads will snap and tube joints will give way.

    After tightening the tube tension nut, put the washer for tube tension nut and look for the nearest matching holes on the face of cartridge for tube tension nut. If necessary slightly unscrew the tube tension nut and secure the lock washer by tightening the bolts firmly. Fit the bearing cover drive side.

16. Connect the delivery pipe line. Check the level of the Discharge Head/motor stool again and after loosening the foundation bolts, attain the required level by adjusting the delivery pipe line by putting wedges in the masonery hole through while the delivery pipe line passes or by adjusting shims below the Discharge Head/motor stool. Embed the delivery pipe line in the mansonary after the proper level is obtained. Check up the level once again and bolt the Discharge head/ motor stool on the foundation. In any case the load of delivery pipe and its accessories should not come on the discharge head/motor stool or column pipe.

PROCEDURE FOR ERECTION OF SELF WATER LUBRICATED PUMPS

1. Put the 'O' rings on bearing spider.

2. Fit the bearing spider alongwith rubber bearing on taper column pipe.

3. Suspend the column pipe and intermediate shaft in such a way that shaft protrudes out of column pipe.

4. Connect intermediate shaft with impeller shaft by threaded barrel/muff coupling as explained earlier.

5. Assemble column pipe with taper column pipe.

6. Repeat this procedure till all column assemblies, alongwith discharge tee if provided, is assembled.

7. Assemble the Discharge Head/Lower Motor stool and head shaft to top column assembly.

8. Fit the stuffing box housing if not fitted earlier.

External Clear Water Lubricated Pumps :

Procedure is similar to self-water-lubricated pumps. The only difference being that the bearings are lubricated by external clear water. Shaft enclosing tubes are fitted on the bearing holders. 'O' ring is provided between bearing holder and shaft enclosing tube.

1. The pressure of the external clear water should be 1 kg/cm^2 more than the full valve close pressure developed by the pump.

2. Auxiliary supply of water should be given before main pump operates. Make necessary arrangement of interlocking the auxiliary supply to main pump so that the main pump should automatically stop if the auxiliary supply of water fails for any reason.

3. Pre-lubrication tank is not required for these pumps.

HEAD UNIT ASSEMBLY :

A. HEAD UNIT ASSEMBLY :

1. Grease lubricated Ball Bearings :

a) Clean the thrust bearing housing. Fit the thrust bearing in the thrust bearing housing.

b) Fit the thrust bearing housing on Discharge Head/on the motor stool. Fill the grease in the bearing (only about 1/2 of its volume to be filled with grease).

c) Push the thrust collar on the shaft till it touches, the inner race of the thrust bearing. Put the cover of thrust bearing housing.

2. Oil lubricated Mitchell Type Thrust Bearing :

a) Clean the thrust bearing housing along with lower bearing cover and fit the thrust bearing housing in motor stool.

b) Put the journal bearing taking guide of locating pin kept on thrust bearing housing.

c) Put the thrust bearing segments on journal bearing. Ensure that same punched number is for all the eight pieces of bearing segments to be used in the particular pump. Bearing segments with different punched numbers should not be used.

d) Pour lubricating oil in the thrust bearing housing till the bearing segment just dip into the oil.

e) Mount runer ring on the thrust collar carefully. Push the thrust collar gently till it rests on bearing segments.

f) Pour more oil till its level reaches the mark on the glass of oil level indicator.

g) Put the thrust bearing covers (in two halves).

The lifting of rotating unit as per instructions given below is essential to ensure free rotation of the pump. The adjustment for closed and semi-open impellers is different. The threads on the adjusting nut are left hand.

Enclosed Impeller : (BHR pumps)

Fit the bearing nut on head shaft till it easily touches the thrust collar. Do not tighten it further. Measure the distance between nut and head shaft end by vernier height gauge. Now tighten the shaft nut against the thrust collar such that rotating unit is lifted up. Again measure distance from top surface of nut to shaft end. Lower the rotating unit by half of the total lift. Put the locknut and tight it on the Bearing Nut. Put the countersunk screw on Bearing Locknut and tight it.

Semi Open Impellers : (BHQ, BHM & BHMa PUMPS)

Lift the shaft by turning the adjusting nut until impellers become just free. The pump will turn easily, usually by hand at this point. This is the lowest point of adjustment. Measure the distance between the shaft nut and head shaft end. Now tighten the shaft nut against the thrust collar such that rotating until is lifted up by 1 mm and, lock in this position by using lock nut.

DRIVES :

1. Solid Shaft Vertical Motors :

   i) Fix the upper bearing cover with slots for ratchet pins.

   ii) Fit the coupling key and fit the pump half coupling with ratchet pins on the head shaft. Rotate the coupling by hand or lever. It should move freely. Check the level on motor stool. It should be within 0.05 mm/m length.

   iii) Check the direction of rotation of the motor. It should be clockwise when viewed from top. Place the vertical motor alongwith motor half coupling on motor stool.

   iv) Check the parallel and angular alignment of the couplings. There should be gap of about 6 mm between coupling faces.

   v) The ratchet arrangement provided in the pump is only to prevent reverse rotation due to back flow which may occur at the time of stopping the pump or at the time of accidental power failure.

   vi) Put the coupling pins and tighten the coupling nuts diametrically opposite to each other.

2. Vertical Hollow Shaft Motors/Gear Box

   Remove top cover of motor/gear box and motor coupling. Lift motor using motor hooks. Clean bottom of motor thoroughly away from the head shaft. Now slowly lower the motor over the shaft, taking care not to rest motor on shaft or damage it in any way. Motor will rest on top of discharge head. Never put shim in between motor and discharge head. Rotate the motor so that terminal box is in a desired direction. Match motor holes with those on top of discharge head and tighten with help of nuts and bolts provided. Open motor terminal box. Connect terminals to starter as indicated by motor and starter name plates.

   Switch on current and start motor. See whether it runs in right direction. If not, reverse any two leads of the incoming lines. Check for rotation again. Close terminal box. Slip on motor coupling over the top shaft into place on the hollow shaft. This must be a sliding fit. If necessary file, dress and scrape, but do not use force. Now remove coupling, and try drive coupling key in the top shaft keyway and in the drive coupling keyway. This must be a sliding-fit and not loose. Put the coupling in position.

   Put the coupling nut on the Head shaft, and tight it by hand till it touches the coupling. Measure the distance between coupling nut top surface to shaft end. Tighten the nut so that complete rotor is lifted up completely for BHR pumps. Again measure the distance from coupling top surface to shaft end. Lower the rotor by half of the total lift measured.

For BHM, BHMa and BHQ pump, lift the rotor by 1 to 1.5 mm.

Lock the coupling nut with the help of locking screw.

WARNING

THE MOTOR MUST NOT BE TESTED FOR DIRECTION OF ROTATION WHEN COUPLED TO THE PUMP. IF PUMP ROTATE IN THE WRONG DIRECTION, SERIOUS DAMAGE TO THE PUMP AND DRIVER AND SERIOUS INJURY TO NEARBY PERSONNEL COULD RESULT.

PIPING CONNECTION :

Piping connections are to be made according to outline drawing supplied with the pump.

For Oil Lubricated Pump :

1. Delivery pressure gauge connection.
2. Oil lubrication connection for line shaft bearings.
3. Air Vent connection for column pipe.
4. Cooling water inlet and outlet connections only for Mitchell thrust bearing.
5. If solenoid valve is used then it is to be energized with separate electric connection so that pre-lubrication to the bearings can be made before starting the pump.

For Self-Water-Lubricated Pumps :

1. Delivery pressure gauge connection.
2. Pre-lubrication tank connection.
3. Air Vent connection for column pipe.
4. Cooling water inlet & outlet connections (only for Mitchell thrust bearing)

External Clear Water Lubricated Pumps :

1. Pressure gauge for discharge 'T'.
2. Pressure gauge & inlet water connection for shaft enclosing tube
3. Air Vent connection for column pipe.
4. Air Vent connection for shaft enclosing pipe.
5. Cooling water inlet-outlet connection (only for Mitchell thrust Bearing).

IV. OPERATION :

PRE-LUBRICATION :

a) For First starting : One litre of lubricating oil should be poured as a pre-lubrication of bearings holders. The oil can be poured directly from the plastic pipe or through solenoid/oil feed valve. Oil should be poured slowly as it has to pass through the

grooves of bearings. It takes approx. 3-4 hours to pass 1 litre of lubricating oil. While pouring the oil, coupling should be rotated slowly by hand.

For subsequent startings : The oil should be fed 5 minutes before starting the main pump.

b) Self-Water-lubricated Pumps :

The bearing holders are lubricated by self water when the pump is in operation. Hence for pre-lubrication, clear cold water from pre-lubrication tank should be given for about 5 minutes, before switching on the pump. The coupling should be rotated slowly by hand/lever during pre-lubrication.

c) External Water-Lubricated Pumps :

In these types bearings are lubricated with clear cold water from external source. Before starting the pump, keep the air vent for enclosing tube open and feed the external water till all air is vented out and clear water comes out smoothly from the air-vent.

If possible, make arrangement to interlock the external water source to the main pump such that main pump will stop immediately if external water supply fails for any reason.

PRIOR TO STARTING :

Before starting the pump make sure that :

1. The rotor assembly rotates freely by hand or lever.
2. Minimum submergence is maintained as specified.
3. All air vents are open.
4. Inlet cock for mitchell thrust bearing cooling is open.
5. Pre-lubrication is made as per instructions given above.
6. The supply voltage is within the + or — 5% range of the voltage indicated on the nameplate of the motor.
7. The cock of pressure gauge connection is closed.
8. The oil feed valve has oil feed rate of 10/15 drops per minute (for oil lubricated pumps).
9. The pressure of the external water, in case of external water lubricated pumps, is 1 kg/ cm^2 (one atmosphere) above the full valve close pressure.
10. (a) The discharge valve is in fully closed condition for BHR pumps.

    (b) The discharge valve is in fully open condition for BHM/BHMa/BHQ pumps.
11. The oil filled in the mitchell thrust bearing is up to the mark on oil level indicator.
12. In case of water lubricated pumps, the stuffing box packings are inserted in such a way that their joints are staggered. The gland is not too tight.

PUTTING THE PUMP IN OPERATION :

1. Start the pump. Let the motor pick up full speed.
2. Close the air release valve after air is vented out.
3. Close the cock of pre-lubrication tank. (Self lubricated pumps)
4. Throttle the discharge valve for the specific duty conditions.
5. Check the flow of cooling water in the flow indicator provided on the cooling outlet.

CHECK DURING RUNNING :

Check the following and regulate, if necessary :

1. Un-interrupted flow of cooling water for the pumps with mitchell thrust bearing. Also check the temperature of the cooling water at outlet. It should not exceed 40°C.
2. Pump is running smooth. Check vibration and noise. Vibration should not exceed 0.1 mm. Vibrations can be checked with vibrometer.
3. The gland is not too tight (For water lubricated pumps). There should be a slight leakage of about 40-60 drops per minute through stuffing box.
4. Power consumption is within the limit. Check the current. It should not exceed the value given on the name-plate of the motor.
5. Ensure that there is no mechanical friction in the pump.
6. There is a constant flow of lubricating liquid. Pump should never run without lubrication to the bearings holders and thrust bearings.
7. Head and capacity developed by the pump is as specified on the name-plate of the pump.
8. Check the temperature of the pump and motor bearings. Temperature of the mitchell thrust bearing should not exceed 70°C. The temperature of thrust ball bearing should not be more than 75°C.

STOP THE PUMP IMMEDIATELY, IF ANY DEFECTS, DISCREPANCIES ARE DETECTED AND MUST NOT BE STARTED AGAIN UNLESS THEY ARE RECTIFIED. REPORT IMMEDIATELY TO THE SUPPLIER IF IT IS NOT POSSIBLE TO RECTIFY THE DEFECT.

X. MAINTENANCE :

A. Daily Checks :

1. Pressure gauge reading.
2. Water level in the sump.
3. Voltage & current.
4. Pump & Motor bearing temperature.
5. Oil level in the mitchell type thrust bearing.

6. Un-interrupted flow of cooling water for mitchell thrust bearing.

7. Rate of flow of lubricating oil for oil lubricated pumps.

8. Leakage through stuffing box.

B. Pericdical Maintenance :

1. Replenish the lubricating oil of mitchell type thrust bearing.

2. Replenish the grease for pump & motor bearings.

3. Change the stuffing box packing.

4. Check the strainer (if supplied), is not choked or damaged.

5. Check silt depositon.

6. Caliberate the measuring instruments.

7. Check the level on the motor stool as there is possibility of resetting of foundation in course of time or disturbance in delivery pipe line.

IMPORTANT :

If the pump stands idle for a long period, it is to be run for a short period once in a week at its max. speed to prevent the shafts and impellers Rubber brgs. from sticking.

Pump should never run dry. Dry running will result into seizing of bearings and other mating surfaces.

OVERAULING :

1. With normal daily operating spell the pump will be due for overhaul after about every three years. This work should be carried out by specialized personnel.

2. All parts are to be cleaned and to be checked thoroughly for wear and tear after dismantling. Following parts are to be checked for clearances. If it exceeds those given below, the parts are to be replaced.

	Maximum clearance in mm (Diametrically)
a) Impeller & Casing ring (BHR pumps)	1 mm
b) Impeller & Impeller guide piece (BHM/BHMa/BHQ pumps)	2 mm
c) Shaft & Bearing bush	0.8 mm

3. The rubber rings & rubber bearings used for water lubricated pumps must not come in contact with grease, oil, petrol, paint etc. These parts are to be cleaned in clear cold water.

4. While ordering for spare parts, the details of the name-plate must be quoted in full, particularly the name of the pump, order No., pump machine No., Part No. and name of the spare parts required and quantity. (Cross Sectional drawings & spare part lists are given on page 27 & onwards). However if individual drawing against order is supplied then the same to be referred.

5. Keep the sufficient stock of spare parts in order to meet the emergency requirement.

XI. TECHNICAL SPECIFICATIONS :

LUBRICATION :

1. Lubricating oil for pump with Mitchell Thrust bearing should conform to following specifications :

Viscosity	— 3° to 5° Engler at 50°C
Flash point	— 180°C
Pour point	— 0 to 5°C
Water content	— not above 0.1%
Ash content	— not above 0.05%
Hard asphalt	— 0% Neutralisation number not above 0.3 mgr.

Following grades of oil conforming to above specification are available in the market :

1. Indian Oil Corporation — Servosystem 57
2. Hindustan Petroleum — ENKLO-53

Quantity of oil : bearing type	Quantity in litres
T3	3
T4	7
T5	27

IMPORTANT :

The oil for mitchell thrust bearing in the bearing housing should be filled up to the mark on the oil level indicator with the pump idel. Oil should not be replenished during operation. Maximum temperature of the oil should not exceed 70°C. The oil should be removed before it becomes black, and the oil reservoir cleaned at the same time. As a rough guide, the oil should be changed every two months.

COOLING WATER FOR MITCHELL THRUST BEARING :

The quantity of cooling water required for pumps at 1450 rpm is as under :

3.5 Lits/Min	For T3 Bearing
7.5 Lits/Min	For T4 Bearing
14 Lits/Min	For T5 Bearing

There should be un-interrupted flow of cooling water and which would be checked from the flow indicator located in the cooling water outlet.

GREAST LUBRICATION FOR THE PUMPS WITH THRUST BALL BEARINGS :

a) Thrust ball bearing is grease lubricated. Grease should conform to —

1. Hindustan Petroleum—LITHON-3 CR NATRA-3
2. Caltex—REGAL STARFAK No. 2
3. Indian Oil—SERVOGEM-3

b) Refilling period : After every 1000 hours of running (approx).

Max. Temp. of bearisng : 40°C above ambient temp.

LUBRICATION FOR OIL LUBRICATED PUMPS (Lubrication for line shaft bearings) :

The oil for lubrication of bearing holders should conform to grade SAE-10 or its equivalent.

Following grades of oil available in the market are suitable

Indian Oil Corpn.	— Servo System-32
Hindustan Petroleum	— NUTO 43/ENKLO-44
Tide Water Oil Company	— Veedol Avalon SO
Caltex	— Regal Oil 'A' (R & O)

IMPORTANT :

1. Pump should never run without lubrication.

2. Oil should be free from dirt and dust particles. While pouring the oil in the oil tank, it should be poured through filter provided in the oil tank.

3. During periodical maintenance, the oil tank should be cleaned thoroughly. Also filter should be cleaned and checked for any damage etc.

4. If solenoid valve is supplied, it should be connected to an independent supply. Prior to starting the pump, start the solenoid valve and ensure that it is operating.

5. Oil feed rate should be 10/15 drops per minute. In any case, it should not be below 10 drops/minute. Check the oil feed rate regualrly at the interval of one hour.

STUFFING BOX PACKING :

The stuffing box packing hould conform to Champion type No. 3116 or equivalent. The packing should be changed before it gets hard. The gland should not be tightened too much and should leak slightly. Ensure that the water does not splash up through gland and enter thrust bearing housing through lower bearing cover and mix up with oil.

PUMPS WITH EXTERNAL WATER LUBRICATION :

The external water provided for bearing holder must be clear cold water. The pressure of the external water must be 1 atmoshpere above the full valve open pressure of the pump. This pressure should be checked where it is introduced in the shaft enclosing tubes. The quantity of the water will be about 3 to 4 L/min when bearings are new and will gradually increase to 30 L/min when they are worn out. Hence while selecting lubricating water pump, quantity of 30 Lts/Min should be considered. The pump should not be started unless all air is vented out through shaft enclosing tubes by feeding external pressurized water. It is essential to expel the air from shaft enclosing tubes from time to time by operating the air-vent, when the pump is in operation.

WARNING : Rubber brgs. should never run dry.

XII. PUMP TROUBLES AND THEIR REASONS :

A. VIBRATION :

1. Weak foundation

2. Faulty design of pump house

   a) Inadequate water level

   b) Faulty flow pattern at suction, such as high velocities, turbulance etc.

   c) Faulty layout of pumps.

3. Defective outlet system

The outlet system may generate streasses on the pumping equipment due to

a) Setting of the soil or its supports.

b) Expansion or contraction in the length of the pipe line.

c) Disturbances carried to the pumping set while replacing the outlet system elements etc.

B. PUMP TAKES TOO MUCH POWER :

1. Mechanical friction
2. Misalignment
3. High specific gravity
4. High speed of primemover
5. Defects in primemover

C. LOW DISCHARGE :

1. High total bowl head
2. Inadequate water level
3. Improper inlet system
4. Choking of strainer
5. Turbulence in sump
6. Air in sump water
7. Leakage in main pipe line
8. Low speed of primeover

D. LOW PRESSURE :

1. Speed too low
2. Air in water
3. Wearing of hydraulic parts
4. High total Head :

    1. HIgh frictional losses
    2. Choking of outlet system

E. PUMP IS NOISY :

1. Hydraulic Noise :

    a) Cavitation—inadequate submergence

b) Turbulences and air mixture in sump water

c) Restricted passage for the entry of water into the bowl.

2. Mechanical Defects :

a) Misalignment

b) Vibration

c) Bending of the shaft

d) Inadequate and improper lubrication

e) Dry running of pump

f) Misfitting

F. HEATING AND WEARING OF BEARINGS :

1. Insufficient lubrication

2. Excessive lubrication

3. Poor quality of lubricant

4. Misalignment

5. Dirt in the bearings

G. JAMMING :

1. Misfitting

2. Misalignment

3. Bend in shaft

4. Dry running of pump

5. Failure of bearings

H. RAPID WEAR OF PARTS :

1. Misfitting

2. Abrasive content

3. Improper selection of material

GENERAL INFORMATION & SAFETY INSTRUCTIONS

1.0) The products supplied by KBL have been designed with safety in mind. Where hazards cannot be eliminated, the risk has been minimised by the use of guards and other design features. Some hazards cannot be guarded against and the instructions below MUST BE COMPLIED WITH for safe operation. These instructions cannot cover all circumstances. Installation, operation & maintenance personnel must use safe working practices at all the times.

1.1) KBL products are designed for installation in designated areas, which are to be kept clean and free of obstructions that may restrict safe access to the controls and maintenance access points.

A Pump Duty Nameplate is fitted to each unit and must not be removed. Loss of this plate could make identification impossible. This in turn could affect safety and cause difficulty 'In obtaining spare parts. If accidental loss or damage occur, contact KBL immediately.

1.2) Access to the- equipment should be restricted to the person net responsible for installation, operation and maintenance and they must be trained, adequately qualified and supplied with appropriate tools for their respective tasks.

1.3) Most accidents involving product operation, maintenance and repair are caused by failure to observe safety rules or precautions. An accident can often be avoided by recognizing potentially situations before an accident occurs. A person must be aware of potential hazard associated in activities of installation, operation & maintenance of equipments.

1.4) KBL requires that, all personnel that are responsible for installation, operation or maintenance of the equipment, have access to and study the product instruction manual BEFORE any work is done and that they will comply with all local and industry based safety instructions and regulations.

1.5) Ear defenders should be worn where the specified Equipment noise level exceeds locally defined safe Levels. Safety glasses or goggles or face shield should be worn where working with pressurised systems and hazardous substances. Other personal protection equipment must be worn where local rules apply. Wear safety shoes, helmets and cotton overalls (Apron) when you enter pump house. Noise level should not exceed 90 dbA and 110 dbA for motor driven and engine driven pumps respectively.

1.6) Do not wear loose clothing or jewelry, which could catch on the controls or become trapped in the equipment.

1.7) Read the instruction manual before installation, operation or maintenance of the equipment. Check and confirm that the manual is relevant copy by comparing pump type on the nameplate and with that on the manual.

1.8) Note the 'Limits of product application permissible use' specified in the manual. Operation of the equipment beyond these limits will increase the risk from hazards noted below and may lead to premature and hazardous pump failure.

1.9) Clear and easy access to all controls, gauges and dials etc. must be maintained at all times. Hazardous or flammable materials must not be stored in pump rooms unless safe areas or racking and suitable container,have been provided.

1.10) Use suitable earthing and tripping devices for electrical equipments.

2.1) IMPROPER INSTALLATION, OPERATION, MAINTENANCE, LUBRICATION, REPAIR OF THIS KBL PRODUCT COULD RESULT IN INJURY OR DEATH.

If tool, procedure work method are operating technique not specifically recommended by KIRLOSKAR BROTHERS LIMITED is used, it should be ensured that it is a safe for personnel around and others. It should also be ensured that the product will not be damaged or made unsafe by the operation, lubrication, and maintenance or repair procedures you choose.

3.0) SAFETY INSTRUCTIONS WHILE HANDLING AND STORAGE

When lifting the pump, use the lifting points specified on general arrangement drawing, if provided. Use lifting equipment having a safe working load rating suitable for the weight specified. Use suitable slings for lifting pump, which is not provided, with lifting points. The use of forklift truck and chain crane sling equipment is recommended but locally approved equipment of suitable rating may be used. While lifting, the equipment adjusts the center of gravity, so that it is balanced properly.

Do not place fingers or hands etc. into the suction or discharge pipe outlets and do not touch the impeller, if rotated this may cause severe injury. To prevent ingress of any objects, retain the protection covers or packaging in place until removal is necessary for installation. If the packaging or suction and discharge covers are removed for inspection purposes, replace afterwards to protect the pump and maintain safety.

4.0) SAFETY INSTRUCTIONS WHILE ASSEMBLY & INSTALLATION

Shaft alignment must be checked again after the final positioning of the pump unit and connection to pipework as this may have disturbed the pump or motor mounting positions. If hot liquids (above 80°C) are being pumped, alignment should be checked and reset with the pump and motor at their normal operating temperature. If this is not possible, KBL can supply estimated initial offset figures to suit extreme operating temperatures. Failure to support suction and delivery pipework may result in distortion of the pump casing, with the possibility of early pump failure.

5.0) SAFETY INSTRUCTIONS WHILE COMMISSIONING & OPERATION

Never attempt adjustments while the pump is running, unless otherwise specified in the operation, maintenance manual.

Do not touch any moving or rotating parts. Guards are provided to prevent access to these parts, where they have been removed for maintenance they must be replaced before operating the equipment.

Check that the pump is primed. Pump should never be run dry as the pumped liquid acts, as lubricant for the close running fits surrounding impeller and damage will be incurred.

Failure to supply the stuffing box or mechanical seal with cooling of flush water may result in damage and premature failure of the pump.

Do not touch surfaces, which during normal running will be sufficiently hot to cause injury. Note that these surfaces remain hot after the pump has stopped, allow sufficient time for cooling before maintenance. Be cautious and note that other parts of the pump may become hot if a fault is developing.

Do not operate water pumps in temperatures below freezing point, without first checking that the pumped fluid is not frozen and the pump is free to turn. Pumps in these environments should be drained down during inactivity and re-primed before starting.

In addition to local or site regulations for noise protection, KBL recommend the use of personal ear protection equipment in all enclosed pump rooms and particularly those containing diesel engines. Care must be taken to ensure that any audible alarm or warning signal can be heard with car defenders worn.

Be aware of the hazards relating to the pumped fluid, especially the danger from inhalation of noxious and toxic gases, skin and eye contact or penetration. Obtain and understand the hazardous substance data sheets relating to the pumped fluid and note the recommended emergency and first aid procedures.

6.0) SAFETY INSTRUCTIONS WHILE MAINTENANCE & SERVICING

Do not attempt repairs, you do not understand. Use proper tools.

Before attempting any maintenance on a pump particularly if it has been handling any form of hazardous liquid, it should be ensured that the unit is safe to work on. The pump must be flushed thoroughly with suitable cleaner to purge away any of the product left in the pump components.

This should be carried out by the plant operator. and a certificate of cleanliness obtained before starting work. To avoid any risk to health it is also advisable to wear protective clothing as recommended by the site safety officer especially when removing old packing, which may be contaminated

Isolate the equipment before any maintenance work is done. Switch off the main supply, remove fuses, apply lockouts where applicable and affix suitable isolation warning signs to prevent inadvertent reconnection. In order to avoid the possibility of maintenance personnel inhaling dangerous fumes or vapours locations by removal of bearing housing and shaft assembly to a suitable maintenance area.

Check and ensure that the pump operates at below the maximum working pressure specified in the manual or on the pump nameplate and before maintenance, ensure that the pump is drained down.

Wear a suitable mask or respirator when working with packing and gasket contain fibrous material, as these can be hazardous when the fibrous dust is inhaled. Be cautious, if other supplier's components have been substituted for genuine KBL parts, these may then contain hazardous materials.

Store all oily rags or other flammable material in a protective container in a safe place. Do not weld or flame cut on pipes/tubes that contents flammable fluids. Clean them thoroughly with nonflammable solvent before welding or flame cutting on them. Use solvent/chemical resistant gloves for hand protection.

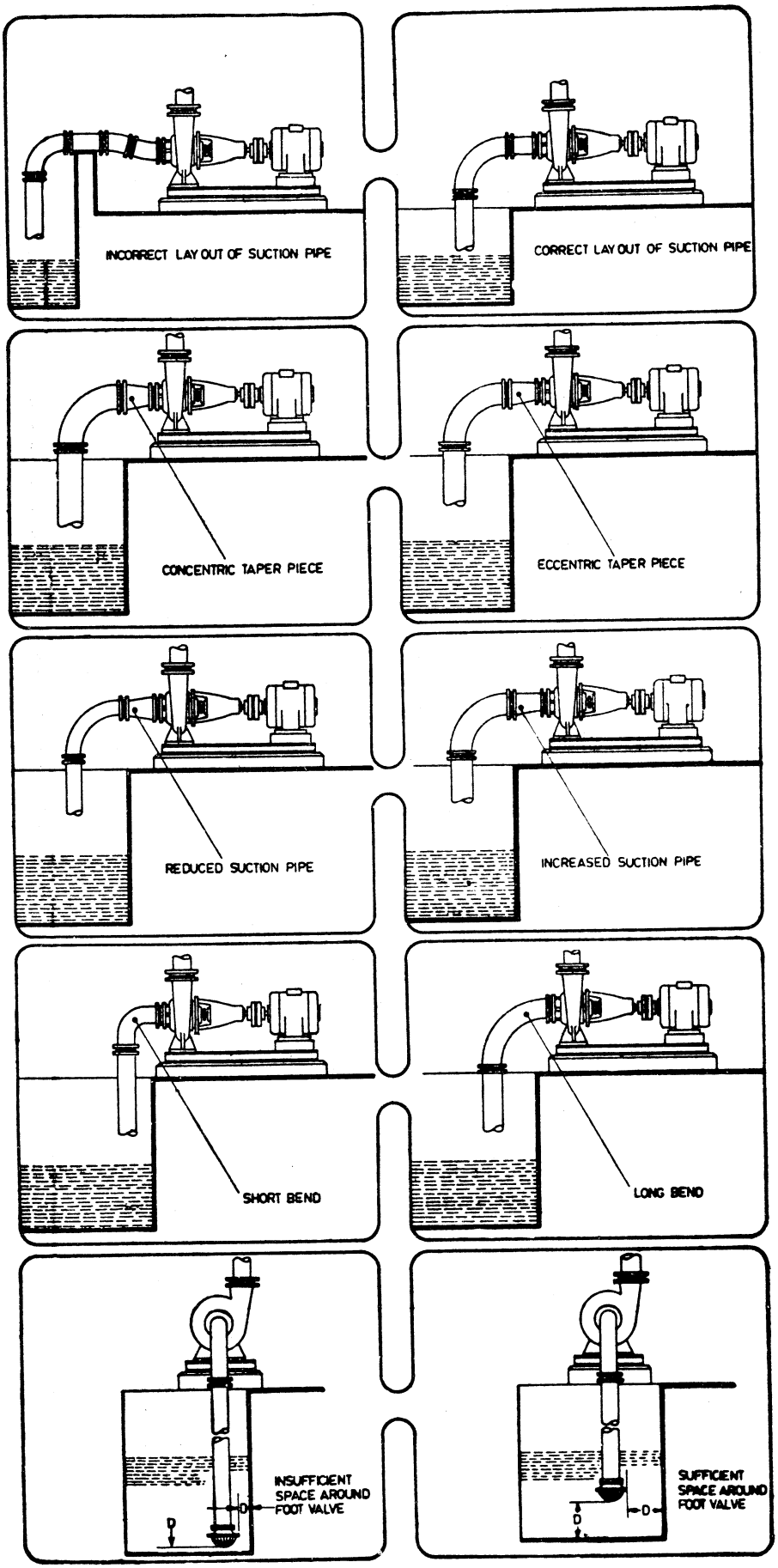
Dispose of all wastes like gaskets, gland packing, oil, batteries, packing material etc. in accordance with local regulations. Normally this would involve incineration of liquid waste and controlled landfill of polymerised material.

Adequacy of suitable crane should be checked before lifting the purnp/pump components. Also condition of pulleys, chain and lifting shackles should be checked before use.

Enriching Lives

INCORRECT

CORRECT



FOR RECOMMENDATIONS OF SUITABLE SUCTION AND DELIVERY PIPE SIZE PLEASE CONTACT OUR AUTHORISED DEALER OR NEAREST REGIONAL OFFICE

GENERAL INSTRUCTIONS FOR INSTALLATION OPERATION & MAINTENANCE OF KIRLOSKAR CENTRIFUGAL PUMPS

GENERAL INSTRUCTIONS FOR INSTALLATION, OPERATION & MAINTENANCE OF KIRLOSKAR CENTRIFUGAL PUMPS

WARNING

The equipment supplied is designed for specific capacity, speed, pressure and temperature. Do not use the equipment beyond the capacities for which it is manufactured. The equipment manufactured is also shop tested for the satisfactory performance and if it is operated is excess of the conditions for which it is manufactured, the equipment will be subject to excessive stresses and strains.

LOCATION

The pump should be located as near the liquid source as possible. This will minimise the suction lift and pump will give better performance.

Ample space should be provided on all the sides so that the pump can be inspected while in operation and can be serviced conveniently whenever required.

FOUNDATION

The foundation should be sufficiently substantial to absorb any vibration and to form a permanent rigid support for the base plate. This is important in maintaining the alignment of a direct connected unit. A concrete foundation on a solid base is advisable. Foundation bolts of the proper size should be embedded in the concrete located by a drawing or template. A pipe sleeve about two and one-half diameter larger than the bolt should be used to allow movement for the final position of the foundation bolts.

ALIGNMENT

Pumps and drivers that are supplied by the manufacturers, mounted on a common base plate are accurately aligned before despatch. However as the alignments are likely to be disturbed during transit to some extent and therefore must not be relied upon to maintain the factory alignment. Re-alignment is necessary after the complete unit has been levelled on the foundation and again after the grout has been set and foundation bolts have been tightened. The alignment must be checked after the unit is piped up and re-checked periodically.

FLEXIBLE COUPLING

A flexible coupling will not compensate for misalignment of the pump and driver shafts. The purpose of the fiexible coupling is to compensate for temperature changes and to permit the movement of the shafts without interference with each other while transmitting power from the driver to the pump.

TYPE OF MISALIGNMENT (SEE FIGURE 1)

There are two types of misalignment between the pump shaft and the driver shaft.

(a) Angular misalignment : Shafts with axis concentric but not Parallel.

(b) Parallel misalignment : Shafts with axis Parallel but not concentric.

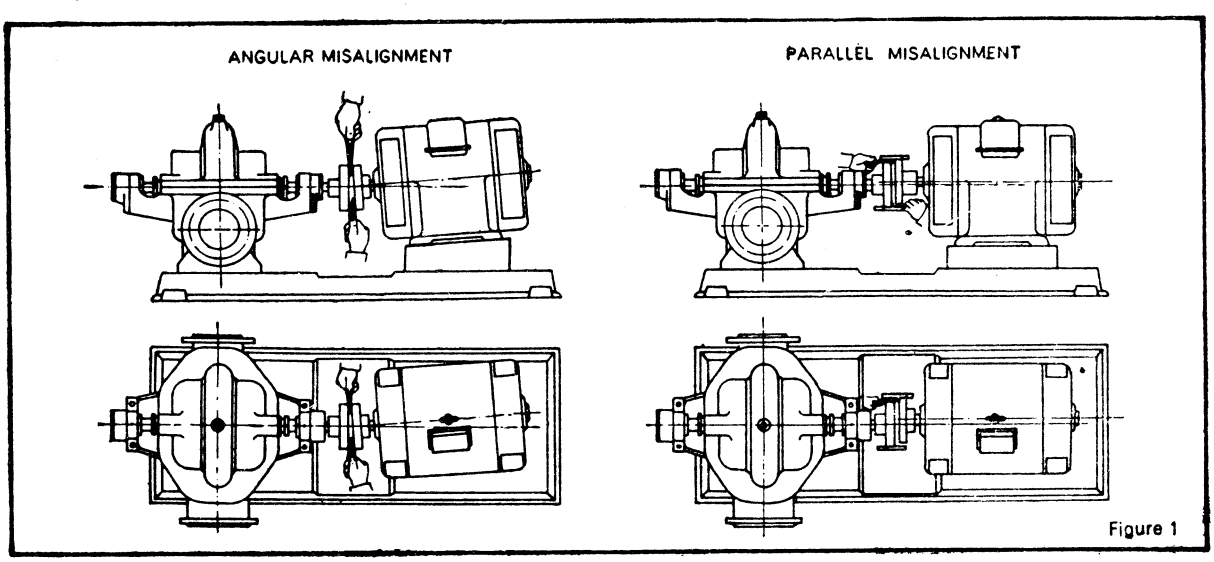


Figure 1

LEVELLING THE UNIT

When the unit is received with the pump and driver mounted on the base plate, it should be placed on the foundation and the coupling halves disconnected. The coupling should not be reconnected until all alignment operations have been completed. The base plate must be supported evenly on wedges inserted under the four corners so that it will not be distorted or sprung by the uneven distribution of the weight. Adjust the wedges until the shafts of the pump and driver are in level. Check the coupling faces. suction and discharge flanges for the horizontal or vertical position by means of spirit level.

FLEXIBLE COUPLING ALIGNMENT (SEE FIGURE 2)

The two halves of the coupling should be at least 4 mm apart so that they cannot touch each other when the driver shaft is rotated. Necessary tools for approximately checking are straight-edge and on an outside caliper.

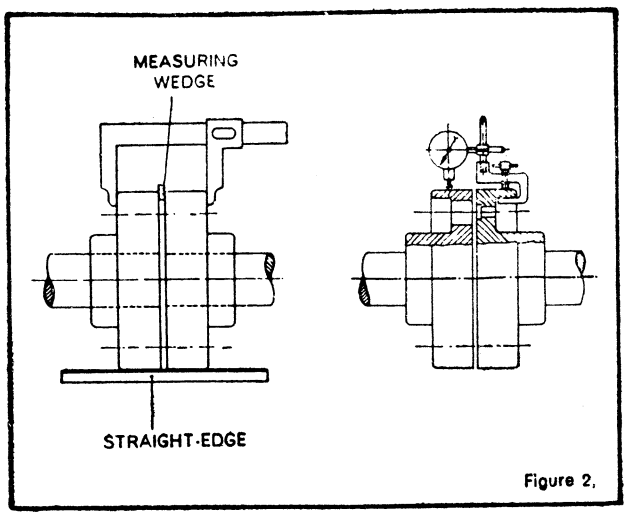
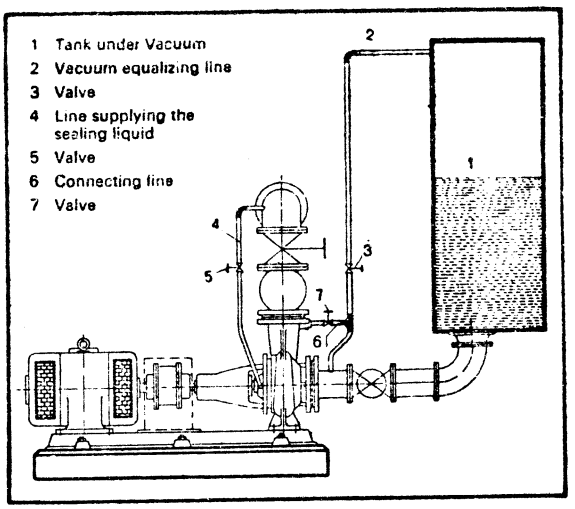


Figure 2.



A check for parallel alignment is made by placing a straight-edge across both coupling periphery at the top, bottom and both the sides. The unit will be in parallel alignment when the straight-edge rests evenly on the coupling periphery at all positions. Care must be taken to have the straight-edge parallel to the axis of the shafts.
A check for angular alignment is made by using an outside caliper across the width of the coupling faces at various points.
Coupling alignment can be checked with dia gauge indicator as shown in Fig. 2.

GROUTING

When the alignment is correct, the foundation bolts should be tightened evenly but not too firmly. The unit can then be grouted by working soft concrete under the edges. Foundation bolts should not be fully tightened until the grout is hardened, usually 48 hours after pouring.

FACTORS THAT MAY DISTURB ALIGNMENT

The unit should be periodically checked for alignment. If the unit does not stay in line after being properly installed, the following are possible causes :

(a) Setting, seasoning of the foundation.
(b) Pipe strains distorting or shifting the machines.
(c) Wear of the bearings.

PIPING

Both suction and delivery pipes and accessories should be independently supported near the pump so that when the flanges bolts are tightened no strain will be transmitted to the pump casing. It is usually advisable to increase the size of both suction and delivery pipes at the pump nozzles in order to decrease the loss of head from friction and for the same reason piping should be arranged with as minimum bends as possible, as these should be made with a long radius wherever possible. The pipe lines should be free from scales, welding residuals etc., and have to be mounted in such a way that they can be connected to suction and delivery flanges without any stress on the pump. Adequate supports should be given to pipe lines to that the weight of the pipe lines does not fall on the pump. The use of minimum number of the bends and other fittings will minimise the frictional losses.

SUCTION PIPE

The suction pipe should be as short as possible. This can be achieved by placing the pump near the liquid to be pumped. The suction pipe must be kept free from air leaks. This is particularly important when the suction lift is high. A horizontal suction line must have a gradual rise to the pump. Any high point in the pipe will be filled with air and thus prevent proper operation of the pump. A concentric taper piece should not be used in a horizontal suction line as it forms an air pocket in the top of the reducer and the pipe. Use an eccentric piece instead.
The end of the suction pipe must be well submerged to avoid whirlpools and ingress of air but must be kept clear of any deposits of mud, silt grit etc. The pipe must be clear from any side of wall by at least 450 mm. The end of the suction pipe should be provided with a strainer of sufficient open area.

DELIVERY PIPE

A check (non-return) valve and a gate of sluice valve (regulating valve) should be installed in the discharge line. The check valve placed between the pump and the gate valve is to protect the pump from excessive pressure and to prevent water running back through the pump in case of failure of the driving machine.
Discharge piping should be provided with a sluice valve adjacent to the delivery flange to control the discharge, if required.

VACUUM EQUALIZING LINE (AND LIQUID LINE) (SEE FIGURE 3)

If the pump draws from a system under vacuum an equalizing pipe must be carried from the highest point of the suction line, however, as close to the suction flange of the pump as possible, to the top of the feed tank to keep gas bubbles that might have been entrapped in the flow from entering the pump. The line should be fitted with an isolating valve which should be closed only for maintenance work on the pumpset.
Apply sealing liquid (external sealing) to the shaft seal cage to prevent entry of air in the case of pumps with packed stuffing box. It is convenient to tap the sealing liquid from the delivery line above the non-return valve.

FOOT VALVE

It is advisable to install a foot valve to facilitate priming. The foot valve should have sufficient clear passage for water. Care must be taken to prevent foreign matter from being drawn into the pump or choking the foot valve and for this purpose an efficient strainer should be provided.

STUFFING BOXES AND PACKING

Stuffing boxes should be carefully cleaned and the packing placed in them. Be sure that sufficient packing is placed at the back of the water seal cage. If the water to be pumped is dirty or grity, sealing water should be piped to the stuffing boxes from clean outside source of supply in order to prevent damage to the packing and shaft. In placing the packing, each packing ring should be cut to the proper length so that ends come together but do not overlap. The succeeding rings of packing should not be pressed too tight as it may result in burning the packing and cutting the shaft. If the stuffing box is not properly packed, friction in stuffing box prevents turning the rotor by hand. On starting the pump it is well to have the packing slightly loose without causing an air leak, and if it seems to leak, instead of putting too much pressure on the gland, put some heavy oil in the stuffing box until the pump works properly and then gradually tighten up the gland. The packing should be occasionally changed.

BALL BEARINGS

Correct maintenance of ball bearings is essential. The bearing manufacturers give the following as a guide to relubrication periods under normal conditions.

Three monthly when on continuous duty.

Six monthly when on eight-hour per day duty.

The bearings and housings should be completely cleaned and recharged with fresh grease after 2500 hours or the nearest pump overhaul time.

PRIMING

No pumping action occurs unless the pump casing is filled with liquid. Pump casing and suction pipe must therefore be completely filled with the liquid and thus all air removed before the pump is started. Several different priming methods can be used depending on the kind of installation and service involved.

(1) Liquid level above pump level.
Pump is set below liquid level of source of supply so that liquid always flows to pump under positive head.

(2) Priming with Foot Valve.
(a) When pump is installed on suction lift with foot valve at the end of suction line, fill pump with water from some outside source till all air is expelled and water flows through air vent.
(b) When there is liquid under some pressure in the discharge pipe, priming can be effected by byepassing the pressure liquid around the check and gate valve. Of course, the initial priming must be effected from some outside source.
NOTE : In this case, the foot valve must be capable of withstanding pump pressure and possible surge.

(3) Priming by ejector : An ejector operated by steam, compressed air or water under pressure and connected to air vent on top of casing can be used to remove air from and prime the pump on suction lift installations.

(4) Priming by dry vacuum pump : A hand or power pump sucks in all the air from the casing and the suction pipe, and thus primes the system.

STARTING

The pump must not be started without being primed. Be sure that the driver rotates in the proper direction as indicated by a direction arrow on the pump casing.

RUNNING

On account of its simple construction, the centrifugal pump requires practically no attention while running. Lubrication of the bearings and manipulation of the glands are the only things that need attention from the operator.

STOPPING

Before stopping the pump, close the gate valve. This will prevent water hammer on check valve.

STUFFING BOXES

Do not tighten the glands excessively. A slight dripping of water from the stuffing boxes when pump is running keeps packing in good condition.

CASING RINGS

Casing rings are fitted in the casing to reduce the quantity of water leaking back from the high pressure side to the suction side. These casing rings are fitted to maintain a small clearance and depend on the water in the pump for lubrication. When they are worn out, the clearance becomes greater and more water passes back into the suction. They must be replaced from time to time to restore the pump efficienoy to its normal value.

SPARE PARTS

A set of ball bearings, a set of casing rings and a set of gland packing rings must always be kept at hand to ensure uninterrupted service from the pump. While ordering for spare parts, always give type, size and serial number of the pump as stamped on the name plate.

PUMP TROUBLE

When investigating trouble with Kirlóskar pumps, always remember that pumps have been tested at the factory and are mechanically correct when sent out. Discounting the possibility of damage during transit, most of the trouble in the field is due to faulty installation. Investigation shows that the majority of troubles with centrifugal pumps result from faulty conditions on the suction side.

BREAKDOWN-CAUSE-CHECK POINTS

In case of breakdown we recommend the location of the fault by using the following table.

BREAKDOWN	CHECK POINTS
Pump does not deliver	1 7 8 9 10 11 12 14 15 17 18 19 23 25 26 56 57 58
Pump delivers at reduced capacity	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 17 18 19 20 21 22 56 57 58
Delivery performance deteriorates	1 3 7 9 10 11 12 13 14 19 20 21 22 23 24 53 57 62
Pump delivers too much	16 56 57 58
Delivery is interrupted	1 3 6 7 8 9 10 11 12 13 14 15 16 19 22 23 25 26 56 57 58 62
After stopping pump runs in reverse direction	52
Very noisy	1 2 5 6 7 8 11 12 13 15 19 20 22 54 55 56 57 62
Unsteady running of pump	19 20 22 31 32 33 35 36 37 38 39 40 43 44 47 48 49 50 51 54 55 58
Stuffing box leaks excessively	24 27 28 29 30 31 47 48 49 53
Fumes from stuffing box	22 23 24 25 26 27 28 29 30 41 42 43
Pump rotor locked in standstill position.	22 45 46 50
Pump is heating up and seizing	23 24 25 26 27 28 29 30 40 41 42 45 46 47 48 49 50 54
Bearing temperature increases	19 20 21 22 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 51 54 55 58
Motor will not start	14 22 60
Motor gets hot or burns out	14 22 27 28 40 43 50 55 56 57 58 59 60 61
Motor is difficult to start	14 22 27 28 45 46 50 58 59 60

CHECK POINTS

1 Suction pipe, foot valve choked.
2 Nominal diameter of suction line too small.
3 Suction pipe not sufficiently submerged.
4 Too many bends in the suction line.
5 Clearance around suction inlet not sufficient.
6 Shut off valve in the suction line in unfavourable position.
7 Incorrect layout of suction line (formation of air pockets).
8 Valve in the suction line not fully open.
9 Joints in the suction line not leak-proof.
10 Air leaking through the suction line & stuffing box etc.
11 Suction lift too high.
12 Suction head too low (difference between pressure at suction connection and vapour pressure too low).
13 Delivery liquid contains too much gas and/or air.
14 Delivery liquid too viscous.
15 Insufficient venting.
16 Number of revolutions too high.
17 Number of revolutions too low.
18 Incorrect direction of rotation (electric motor incorrectly connected, leads of phases on the terminal block interchanged).
19 Impeller clogged.
20 Impeller damaged.
21 Casing rings worn out.
22 Separation of crystals from the flow of pumping liquid (falling below the temperature limit/equilibrium temp).
23 Sealing liquid line obstructed.
24 Sealing liquid contaminated.
25 Lantern ring in the stuffing box is not positioned below the sealing liquid inlet.
26 Sealing liquid omitted.
27 Packing incorrectly fitted.
28 Gland tightened too much/slanted.
29 Packing not suitable for operating conditions.
30 Shaft sleeve worn in the region of the packing.
31 Bearing worn out.
32 Specified oil level not maintained.
33 Insufficient lubrication of bearings.
34 Ball bearings over-lubricated.
35 Oil/Grease quality unsuitable.
36 Ball bearing incorrectly fitted.
37 Axial stress on ball bearings (no axial clearance for rotor).
38 Bearings dirty.
39 Bearings rusty (corroded).
40 Axial thrust too great because of worn casing rings, relief holes obstructed.
41 Insufficient cooling water supply to stuffing box cooling.
42 Sediment in the cooling water chamber of stuffing box cooling.
43 Alignment of coupling faulty or coupling loose.
44 Elastic element of coupling worn.
45 Pump casing under stress.
46 Pipeline under stress.
47 Shaft runs untrue.
48 Shaft bent.
49 Rotor parts insufficiently balanced.
50 Rotor parts touching the casing.
51 Vibration of pipe work.
52 Non-return valve gets caught.
53 Contaminated delivery liquid.
54 Obstruction in delivery line.
55 Delivery flow too great.
56 Pump unsuitable for parallel operation.
57 Type of pump unsuitable.
58 Incorrect choice of pump for existing operating conditions.
59 Voltage too low/power supply overloaded.
60 Short circuit in the motor.
61 Setting of starter of motor too high.
62 Temperature of delivery liquid too high.

KIRLOSKAR BROTHERS LIMITED
UDYOG BHAVAN, TILAK ROAD, PUNE 411 002 (INDIA)

HISTORY CARD

Pump Type _____

Serial No. _____

Material Construction _____

O/A No. _____

Total Head _____

Discharge _____

Speed _____

bhp/kw _____

Motor hp _____

Location _____

Application _____

Liquid Handled _____
(Name)

Chemical Composition _____

Sp. Gravity _____ pH Value _____

Temperature _____

Suspended Solid % _____

Nature of Liquid — Abrasive/Corrosive/
Inflammable.

Stuffing Box Packing/Mechanical Seal

Specification _____

Type _____ Size _____

Material Code _____

Sealing/Recirculation Liquid Self/External

Pressure _____ Quantity _____

Cooling Connection Yes/No

Size _____ Quantity _____

Date of Commissioning _____

Special Remarks

ROUTINE MAINTENANCE
(Dates of Replenishing/Refilling/Checking)

Stuffing Box Packing			Lubricating Oil/Grease			Checking	Overhauls

REPLACEMENT DETAILS

Name of Part	Date of Replacement	Reason for Replacement	Serviced by	Remarks
Impeller				
Pump Shaft				
Shaft Sleeve				
Casing Rings				
Bearings				
Stuffing Box Bush/Mech. Seal				
Other Parts				

Enriching Lives

KIRLOSKAR BROTHERS LIMITED

Established 1888

A Kirloskar Group Company

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OUR COMPANIES

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